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## TABLE OF CONTENTS.


ENGINEERING NEWS OF THE WEEK.....342, 345, 363

TECHNICAL ARTICLES:
Crib Dock f r Sigua Iron Co., Cuba (*illustrated*)..... 342
The Engineering Schools of the United States, IV..... 342
A Thin Floor Plate Girder Bridge (*illustrated*)..... 344
Reply to the Engineer's Report on the New Water Supply for Newark, N. J..... 345
The Des Moines (Iowa) Stand-Pipe (*illustrated*)..... 346
Experiments on the Efficiency of Worm Gearing (*illustrated*)..... 348
World's Columbian Exposition; Fuel..... 348
The Comparative Merits of Various Systems of Car Lighting, XV..... 349
Non-Arcing Metals..... 356
Pneumatic Foundations of the Aare Bridge (*illustrated*)..... 356
Type-Setting by Machinery (*illustrated*)..... 357
The Standard Cattleguard (*illustrated*)..... 359
Spark Arresters on English Locomotives..... 359
Driving Levers and Valve Motion of the Johnstone Double Compound Locomotive (*illustrated*)..... 360
Statistics Showing the Progress and Prospects of Railway Construction in States East of Chicago (*with insert*)..... 361

PERSONALS, NEW PUBLICATIONS, SOCIETY PROCEEDINGS..... 350, 351

EDITORIAL NOTES..... 352
Concentration of Land Values in Cities—A Proposed Method of Managing Government Public Works.

EDITORIALS:
The Efficiency of Worm Gearing..... 352
Railway Construction in the States East of Chicago (*with insert*)..... 352
The Need for Uniformity in Railway Laws (*illustrated*)..... 353

LETTERS TO THE EDITOR..... 356
The Austin Dam Cableway.

CONSTRUCTION NEWS..... 364—366
Railways, Electric Railways, Elevated and Cable Railways, Horse and Motor Railways, Highways, Bridges, Tunnels and Canals, Water-Works, Irrigation, Sewers, Streets, Electrical, Contract Prices, Miscellaneous, Manufacturing and Technical, Current Price List.


The cost of pipe sewers laid in Memphis last year, is thus given by Mayor Shakespeare, of New Orleans, in answer to queries put to him: For 2,605 ft. of 10-in. pipe, with 8 manholes, the cost per lin. foot was, for material, 36 6-10 cts.; for labor, 44 9-10 cts.; total, 81 5-10 cts.; per foot; for 5,398 ft. of 8-in. pipe, with 16 manholes and 11 flush-tanks, the figures were, 36 6-10 cts. for material and 56 8-10 cts. per foot for labor, or 93 4-10 cts.; for 1,142 ft. of 6-in. pipe, the material cost 32 3-10 cts. per foot and the labor, 64 8-10 cts., a total of 97 1-10 cts. per foot. In the 10 in. pipe 1,300 ft. of house connections figure in the cost, but not in length given for the pipe. The manholes and flush-tanks cost $30 each.

The draw-bar litigation, going on for the past ten years, between the Manhattan Elevated Railway and Mr. E. O. Perrin, has been decided in the U. S. Circuit Court in favor of the railway company. Mr. Perrin alleged that the company infringed his patent in using the draw-bar that enabled them to turn the sharp curves on the 6th. Ave. line. Judge Wallace decided that Perrin's patent was ante-dated by that of one Deville, in England, in 1833.

The Philadelphia trolley ordinances, giving the Traction Co. power to adopt the trolley system on the main thoroughfares of that city, have been passed over the Mayor's veto by votes of 25 to 10 in Select and 77 to 31 in Common Council. Mayor Stuart based his objection upon the grounds that he was not convinced that the trolley was the best system for use in that city for rapid transit; the ordinances did not contain restrictions and provisions necessary for the adequate protection of the public, and do not provide explicitly for municipal control in details of erection. The interesting feature in the ordinance is that the Traction Co. pays nothing whatever for one of the most valuable concessions ever granted in that city. Verily, the Traction Co. owns Philadelphia, or at least its sworn representatives in Councils.

The cost of building macadam roads in Montclair, N. J., during the past year averaged 92 cts. per lin. ft. or $4,858 per mile. The work was done by contract at 28 cts. per cu. yd. for excavation, and 80 cts. and 83 cts. per lin. ft., for the macadam in place. These roads had an 8-in. depth of macadam, the experience being that roads 6-ins. deep, of which some have been built in the town, require enough repairs to offset their smaller first cost.

The Bombay water-works, described in our issue of May 23, 1891, were formally opened on March 31. They have been under construction for the past seven years, and cost about $5,250,000. The water is drawn from Tansa Lake, an artificial body formed by a dam in the valley, 60 miles from Bombay, and having a superficial area of eight or nine square miles, and a catchment area of 52 square miles. The dam is two miles long, 117 ft. high, 100 ft. thick at the base, and 15 ft. thick at the top. In some places the foundation reaches 45 ft. beneath the level of the soil. The dam contains 11,000,000 cu. ft. of masonry. The water is conveyed by a channel 8 ft. deep to within 15 miles of Bombay, and thence into the city by a 4 ft. iron main. There are 62 miles of tunneling. Thirty-one million gallons of water are supplied daily.

The most serious railway accident of the week was a head collision March 31 at Sparta, Ala., on the Louisville & Nashville R. R. A freight train broke in two, and the rear portion, consiting of five cars in two, and the rear portion, consisting of five cars, ran away down grade and collided with a fast mail train. The engineman and fireman jumped, but one mail clerk was killed, while two other clerks and an express messenger were injured. A serious railway accident, which escaped our notice, was a derailment March 14, on the Wisconsin Central Ry., near Dale, Wis. The engine and mail car remained on the track, but three cars went down the bank. The wreck caught fire, and only the engine and mail car escaped. Only one man was killed, but eight were seriously injured. We learn that the accident happened on a straight track, when the train was running at between 20 and 30 miles an hour. All the cars except two Pullman cars were heated by ordinary stoves. Steam heating is used on all the surburban trains, but on only three or four of the main line trains. Investigations have been in progress for some time as to the different systems of steam heating and couplers, and it has been decided to heat all the trains in this way.

A locomotive boiler explosion occurred on the Long Island R. R., near Long Island City, N. Y., April 6, killing two men and serious injuring three more, two of whom are not expected to live. The engine was pulling a train of flat cars, and the fireman was shoveling coal into the firebox, when the explosion took place. Judging from the press accounts the crown sheet seems to have given away.

An iron roof truss and timber falsework in a new car shop being built at Nashville, Tenn., for the Nashville, Chattanooga & St. Louis Ry., gave way March 31, killing one man and seriously injuring three others. The building is 200 ft. long and 60 ft. wide. All the iron work had been erected, but this truss had not been fastened in place, and it is said the false work was insecure and gave way under the pressure of the wind. The coroner's jury censured the contractors, the Pittsburg Bridge Co., for not having seen to the safety of the structure.

The La Salle St. tunnel at Chicago, Ill which carries La Salle St. under the Chicago River, was flooded las week, stopping all traffic on the footway and cable road. It is thought the roof had been damaged by some deep-draft steamer.

Floods are causing considerable damage in several sections of the country and in Canada, washing away and damaging many bridges. The cofferdam for the Colorado River dam at Austin, Tex., has been badly damaged, about 50 ft. having been carried away.

The wooden highway toll bridge over the Delaware River, at Byram, N. J., took fire at the west, or Pennsylvania, end on March 29, and was totally destroyed, together with the bridge house at the east, or New Jersey, end, which stood about 15 ft. from the Byram passenger station of the Pennsylvania R. R. The station was only slightly damaged. This had been erroneously stated in some papers as the burning of a Pennsylvania R. R. bridge.

The Hudson River tunnel, work upon which has been stopped for some time, has had a mechanics' lien for $26,550 filed against it by S. Pierson & Sons, of London, contractors for the last two years. The sum of $1,500,000 was raised in London in 1889 for a continuation of work on the tunnel and expended, and an attempt, it is said, is now being made to reorganize and obtain more money. About 1,600 ft., out of the total length of 5,600 ft. for one tunnel, yet remains to be driven, and the only work now being done is in keeping up the air pressure to exclude water from the finished work.

The North German Lloyd steamer "Eider" was towed off the rocks on the coast of the Isle of Wight, after a two months' stay thereon, on March 29. The vessel has safely reached Southampton, but a heavy outlay will be required to make good the damage to hull and cabin fittings.

The Pecos canyon bridge was crossed by the first train of five coaches on March 31. Mr. C. P. Hunting, ton and several officials of the Southern Pacific Railroad were in the party. This bridge was illustrated and described in our issue of Feb. 6.

The Nicaragua Canal was made the subject of a state convention in San Francisco, on March 29. This convention was largely attended by delegates from different counties, boards of trades and other commercial bodies. A memorial to Congress was adopted, setting forth the great advantage of this canal to the Pacific states, in war or commerce, and resolutions were further adopted looking to the holding of a national Nicaragua Canal convention at St. Louis, on June 2.

Plans for the new timber dry dock in Brooklyn, 600 ft. long by 70 ft. wide by 28 ft. deep, have been prepared by Civil Engineer Peter C. Asserson. It will stand alongside of the present timber dry dock, which has been fully described in this journal, and be of the same general type of construction. It will be so planned as to utilize the same pumping plant, saving considerable expense, and is designed to accommodate the largest vessels existing or likely to exist. Its cost will be met from the $1,593,000 derived from the sale of Navy Yard lands, near the Naval Hospital, in the city of Brooklyn.

The North River Bridge Co. (G. Lindenthal, Engineer,) has commenced proceedings to condemn property for its right of way under its charter from Congress. A hearing took place in Trenton, before the U. S. Circuit Court, Judge Acheson sitting, in March 29. The Bridge company was represented by ex-Gov. J. D. Bedle, of Jersey City, also by Chas. F. MacLean and Wm. McAdoo, as counsels for the company. The property owners were represented by Gilbert, Collins & Corbin, as counsel. The property owners opposed the appointment of a commission, on the ground of want of jurisdiction in the court, claiming that the bridge company, in the absence of state legislation, had not sufficient authority for such a proceeding. The decision of the judge was to the effect that the power of the bridge company to condemn property required for its right of way was undoubtedly granted it by its charter, and that, therefore, the contention of the property owners had no legal ground to stand upon. Thereupon, the judge appointed a commission, which will meet in a few days to appraise the property. We presume the purpose of these proceedings was merely to establish beyond all dispute or doubt that the national charter gave in fact, as it does in words, full power to condemn the lands needed in both New York and New Jersey, without or in spite of any state legislation. This is doubtless a necessary preliminary to any successful effort to raise the vast sum needed for construction, and presumably will be followed by similar procedures on the New York side.

Chicago, Ill., with a total of a little over 2,000 miles of streets laid down, uses the following paving material: Wooden block, 479.24 miles; macadam, 256.31 miles; stone, 23.34 miles; block asphalt, 3.59 miles; sheet asphalt, 9.01 miles; brick pavement, 0.67 mile, and burned clay, 0.23 mile. The total of paved streets claimed by the city authorities is 772.39 miles, exclusive of 2.39 miles of wood pavement on viaducts and approaches. The city has 2,240 miles of wooden sidewalk out of a total of 2,872 miles. The wood is being slowly replaced by stone and concrete.

The Columbian Exposition, at Chicago, is to cost $22,226,400, according to the latest estimates submitted to the Congressional Committee now visiting the grounds and buildings. This is about $4,000,000 more than the estimate submitted to Congress last year.

The Siemens & Halske Electric Co., of Chicago, Ill., has been organized, with a capital stock of $500,000, Pres., O. W. Meysenburg; Secy., A. W. Wright: Chief Electrical Engineer, Dr. Berliner. Plans for the building on Blue Island Ave. are being prepared, and it is expected that the works will be in operation within three months. The company expects to introduce the Siemens & Halske electric railway with underground conduit, as in use at Budapest (Eng. News, Jan. 31, 1891), and will also undertake the construction of electric railways using overhead trolley wires.

Electric railways are to be permitted on some of the city streets of Chicago, the Council having passed an ordinance authorizing the use of overhead wire trolley systems on about five miles of the crosstown lines, which are comparatively short, and which have not enough traffic to warrant the use of the cable system.

In referring to the proposed elevation of the New York Central Railroad tracks at the Harlem River and the comparative importance of the river and railway traffic, Mr. Chauncey Depew relates the following bit of experience: "Last summer the drawbridge over the Harlem was held open by a boat for 30 minutes in the busiest part of the day. This delay backed up trains on the Hudson River R. R. as far as Croton, on the Harlem R. R. as far as White Plains, and on the New York & New Haven to Greenwich. These trains carried about 25,000 people, nearly all going to business in this city, and the congestion of trains entering the New York Central Station caused a further delay of 30 minutes. The cause of all this annoyance was a tug pulling a barge carrying one calf and a barrel of apples."

## CRIB DOCK FOR SIGUA IRON CO., CUBA.

As is well known, the island of Cuba possesses some of the richest deposits of non-phosphoric Bessemer iron ore in the world. Three of these deposits, which might, perhaps, be better described as all parts of one great deposit, exist near Santiago de Cuba, on the south side of the island. One of these, the Juragua iron mine, has been in operation for above nine years, and there have been shipped from it between 30,000 and 50,000 tons of ore per month since the mine was opened. The magnitude of the mine can be better appreciated when it is said that to bring this ore to Santiago, 15 miles away, where it is loaded into vessels, 22 locomotives and 2,250 cars are now in use, while there are employed in and about the mine from 1,500 to 2,000 men.

The Sigua Iron Co., of Philadelphia, owns another of these deposits and about 60,000 acres of land, most of it mineral lands. On some of this land valuable copper ores are found, but the main deposit is the Bessemer iron ore, before noted, which exists in vast quantities. This "mountain of ore" is now being thoroughly opened up for the shipment of large quantities of ore monthly, and for it the dock which we illustrate herewith has been built by Messrs. Anderson & Barr, the well known contractors.

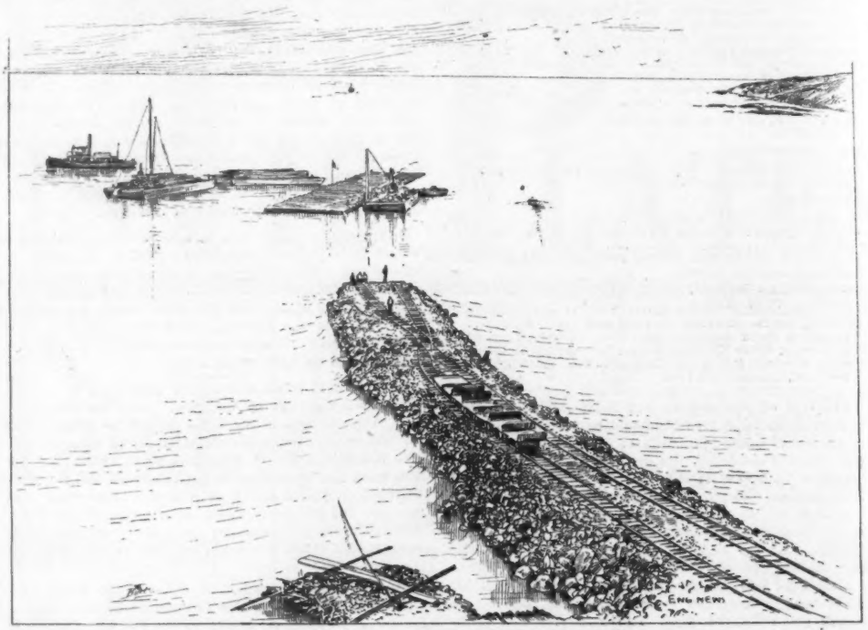
The location of this mine is about 8 miles inland from the coast, about 30 miles from Santiago, and about 800 ft. above the sea. It was required that the ore dock should have a storage capacity for about 5,000 tons of ore, which is provided for by the usual pockets, as shown in the engravings, from which it is stated that a vessel of not over 5,000 tons capacity can be loaded in about two hours. The railway up to the mine has been graded and rails are down to within a mile or so of the loading point. About 12 miles nearer to Santiago de Cuba, and about 5 miles inland, is another deposit, called the Spanish American mine, which is also owned by an American company, and for which another dock similar to that shown on the accompanying drawings was projected and let to the same contractors.

Both of these docks are constructed practically in the open sea, which is made possible only by the fact that the weather there is much less lawless than here. The trade wind springs up between 10 and 11 a. m., and dies out between 4 and 5 p. m., and during these hours makes rather a choppy sea, which yet is practically the same every day, and is not ordinarily heavy enough to cause trouble. The trade wind here blows from the southeast, which is quartering to the dock. During the night, there is only a gentle land breeze which cannot cause trouble; but a more serious element in the problem is that from time to time, usually at intervals of many years, hurricanes and tornadoes occur in this latitude. These all come from the northeast, which is end on to both of the docks. The last of these tornados at the Sigua dock occurred 22 years ago, and may not occur again for a hundred years to come, or may occur any day. It is a risk which cannot be provided against by any feasible method of dock construction, and it is not expected that the dock illustrated will be able to resist such a storm, though the crib part of the dock might possibly do so, but it is intended eventually to construct breakwaters which will protect it, from the waste of the mine or otherwise.

The construction of the dock is sufficiently evident from the drawings. The crib was built in the harbor of Santiago de Cuba, of green palmetto logs about 10 ins. in diameter, and 30 to 40 ft. long, drift-bolted with 30-in. bolts, 3 ft. or less apart. The size of the crib from out to out is 318 ft. by 43 ft. by 33 ft. deep. As the palmetto barely floats in water, the crib sank as it was built from the top, and when finished drew 28 ft. of water, empty and bottomless.

In this condition, with some little risk, but with entire success, it was towed by three tugs 30 miles in the open sea in about 14 hours to its site, as shown in the accompanying view, which represents the crib just after the tugs have cast off, and just as preparations were being made to bring it to its final position. For this latter purpose a scow on which there was an ordinary hoisting engine was lashed to the crib, as shown, and guys were run off to the dock and to one or two buoys anchored in the vicinity. In this way the crib was quickly brought into its proper position. The construction of the crib was begun about Dec. 1, 1891. It was completed and placed in position about Jan. 1, and the filling in and entire superstructure will be finished about May 15. The filling used is one-man stone and gravel. The contract price for the work, the company furnishing all materials for filling, was $50,000. All the fender piles, and the outside row of crib piles, were creosoted yellow pine, purchased in Savannah, Ga. The interior piles were also yellow pine, but not creosoted. The palmetto, as is well known, resists the teredo.

The other dock for the Spanish-American mine was similar in substance to that shown, and was similarly built, but had an unfortunate accident, due to delay in filling in the rock after it was landed.



Ore Dock at Santiago De Cuba; Anderson & Barr, Contractors.

A stiffer breeze than usual caused the carrying away of the upper part of the crib. It is possible that it may yet be concluded to use cast iron cylinders instead of cribwork for this dock, in view of the higher waves to which cribbing seems to be exposed there. The ore produced at all three of these mines is brought to this country and chiefly to Philadelphia.

## THE ENGINEERING SCHOOLS OF THE UNITED STATES.

### IV.

(These papers will be republished in book form, and corrections or proper additions are solicited, and can be made at any time. It is especially desired to make the list of schools claiming to be engineering schools absolutely complete. The temporary use of printed or other documents relating to the early history of engineering schools founded prior to 1870-75, and showing the motives and plans of the founders, early course of study, conditions for graduation, etc., is solicited. Any documents thus loaned will be promptly returned uninjured.)

EARLY ENGINEERING SCHOOLS.—WEST POINT.

The West Point Military Academy, like so many other of the best features of our government, was largely the result of Washington's labors and influence. Its original purpose was to train engineers only for the military service. As early as Oct. 3, 1776, a committee of Congress recommended "that the Board of War be directed to prepare a Continental Laboratory and a Military Academy," and so strong was the sense of need, that even before this report the Continental Congress resolved (Oct. 1, 1776), "That a committee of five be appointed to prepare and bring in a plan of a military academy." Naturally, however, nothing was done during the war, nor in the dismal period of disorganization and governmental weakness between 1783 and the adoption of our present constitution in 1789, nor for ten years thereafter. During the entire period between 1776 and his death in 1799, however, Washington made frequent and urgent recommendations that a military academy be established, and at last, March 16, 1802, the law to authorize it was passed. The form of the law was that a "Corps of Engineers" should be created, consisting of one major, two captains, four lieutenants and ten cadets, with permission to promote and expand until the corps should consist of not over 16 officers and not over 20 in all, leaving room for only four engineer cadets. "The said corps, when so organized, shall be stationed at West Point, and shall constitute a Military Academy." Forty artillery cadets were also authorized to be attached to the academy.

The academy was opened July 4, 1802, with ten cadets, all of whom had been appointed some time before under an existing law, and two of whom, Joseph G. Swift, of Massachusetts, and Simon M. Levy, of Maryland, were graduated the same year. The instruction at first given to the cadets was extremely limited, extending no further than to the mathematics of Hutton's first volume, and the elements of fortification, the last given in lectures from a small pamphlet translated from the French by the first superintendent, Major Jonathan Williams, to whose zeal and devotion the academy owed much, probably its continued existence.

The first cadet graduated, Gen. J. G. Swift, heads the long list of West Point graduates who resigned later to enter upon a distinguished career as civil engineers. Gen. Swift served until 1818, when he was Chief of Engineers and Brevet Brigadier-General. He died in 1865, aged 82. Of the ten original cadets eight were graduated and two dropped out.

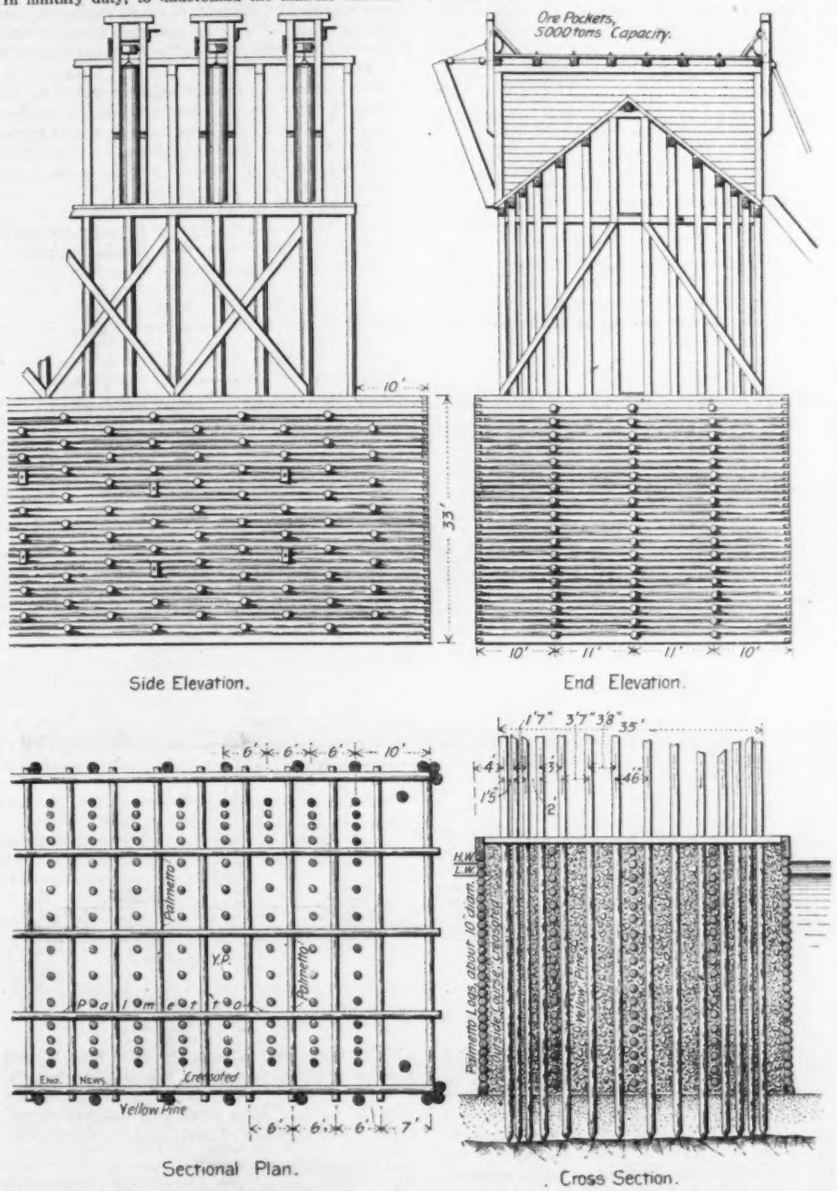
For a long period after the establishment of the academy it was in a deplorable condition. It was not until 1811 that West Point was regarded as the permanent site for the academy. Prior to that date it was taken as a matter of course that it would ultimately be removed to Washington. The food was bad; the quarters flimsy; the discipline loose; and the instruction poor. Very naturally there was no great competition for appointments. For several years not half the number of cadets authorized had been appointed. It was not until 1818 that the academy can be considered to have assumed substantially its present form. Its history prior to that date, as one reads in Gen. Cullum's "Early History of West Point," which is almost the only source of information as to this period, is a pitiful story of narrow-minded folly. There was at one time a strong probability that the academy would be removed to Staten Island as well as to Washington. In 1810 there were only two profes-

sors, and the conditions of graduation were as follows:

In mathematics, to be well versed in arithmetic, logarithms, elements of algebra, geometry, trigonometry, mensuration of heights and distances, planometry, stereotomy, surveying, artificer's work, and conic sections.

In French, to pronounce the language tolerably, and to translate from English into French, and from French into English, with accuracy.

In military duty, to understand the manual exercise with the musket, the management of the field pieces and the various evolutions of the infantry and artillery perfectly.




ORE DOCK AT SANTIAGO DE CUBA FOR SIGUA IRON CO., PHILADELPHIA.

In 1811 there was only one professor and nine cadets. In 1812, when war with England broke out, the academy had practically ceased to exist; but in the same year the bill was passed authorizing the appointment of three professors with the rank of lieutenant-colonel, and of 200 cadets in all. A law had been passed in 1808 authorizing the appointment of 156 more cadets, but between 1802 and 1812 the greatest number of cadets in attendance at any one time was 36, and the average did not exceed 20.

During this period the cadets were of all ages, from 12 to 34, they were either married or unmarried, and they entered at any time without examination. They were often ununiformed. They were housed in barracks with soldiers or boarded in private houses. The discipline was unavoidably loose. There was no real division into annual classes, nor fixed standard for graduation, which was at the discretion of the superintendent, who was its chief friend, as Secretary of War William Eustis was its chief enemy. Both were from Boston, Mass.

By 1815, however, the academy began to get upon its feet again. In 1816 there were 200 cadets, the present uniform was adopted, and four annual classes were established. But an ill-chosen superintendent retarded its growth, and it was not until Col. Sylvanus Thayer (also of Massachusetts; a graduate from the academy in 1807) was appointed superintendent in 1817 that the academy began to be what it is to-day. Col. Thayer held the office for 16 years, and justly earned the title of "father of the academy," which is inscribed on his monument, but which he should in fairness share with Col. Williams. The reforms which he began to introduce from the moment of his appointment, and all of which (except as noted in parenthesis), endure substantially unchanged up to the present day, are thus forcibly described by Gen. Cullum:

Almost by intuition he discovered the virulent ulcers destroying the vital parts of the academy, and such as he could not cauterize into healing, like a bold surgeon, he promptly amputated. Examinations were at once held, the incompetent and vicious dismissed, and the indolent, who had lingered for many years without progress, quickly discovered that a like fate awaited a continuance of their dereliction. He promptly organized the cadets into a battalion of two companies (now four companies), officered by members of their own body, with a colonel at its head and an adjutant and sergeant-major for his staff; appointed an officer of the army as "Commandant of Cadets," responsible for their tactical instruction and soldierly discipline; transacted business with members of his command only at stated office hours; classified all cadets according to their proficiency in studies; divided classes into small sections for more thorough instruction by the teachers in charge; required weekly class reports, showing the daily progress of students according to a scale of marks; directed more thorough recitations and a freer use of the blackboard; greatly improved the curriculum of studies, according to a well-digested program, organized a proper Academic Board, with the superintendent at its head; introduced the check-book system, to curtail the prevailing extravagance of cadets, then deeply in debt; reduced the expenses of educating pupils to less than one-half the cost at the Woolwich Military Academy in England; had the Officer of the Day daily to dine with him, enabling himself thereby to learn all that was transpiring in camp or barracks; required cadets to obtain a permit from him for almost everything, even to a letter from the post office, thus maintaining such constant intercourse as enabled him to call all by name, and understand their characters and habits, and made many other salutary provisions to secure thorough discipline, a high standard of honor, complete physical and mental development, and a generous rivalry for conspicuous soldiership and eminent class rank. The more thoroughly to guarantee the latter, the Secretary of War directed, Feb. 14, 1818, the publishing in the Army Register, of the names of the five cadets of each class most distinguished for attainments and meritorious conduct. Soon after, April 14, 1818, the professorship of geography, history and ethics was established, thus adding new and important elements in the education of cadets.

In this brief sketch it would be impossible to record each prominent event in Thayer's management, and to descant upon the multiform meliorations introduced by him during the sixteen years of his masterly administration, wherein he built up the Military Academy from an elementary school to a model seminary of science and soldiership worthy of a great people. In these sixteen years mathematics, from Hutton's elements, had advanced to a complete course of algebra, geometry, plane and spherical trigonometry, descriptive geometry (including shades, shadows and perspective), surveying and the use of instruments in the field, analytical geometry, and differential and integral calculus. From a little smattering of French, taught to a few in 1817, some in 1833 became sufficiently proficient to speak the language, most to read it fluently, and all to translate readily scientific text books and professional works. Drawing, confined mostly to copying a few traces of fortifications and a slight use of the brush, had progressed to the delineation of the human figure, pen and pencil landscapes, and topography in all styles of representation. Natural and experimental philosophy, from what is to be found in Enfield, had grown to an extended course in physics, dynamics, hydrostatics, hydrodynamics, magnetism, electro-magnetism, optics, and astronomy, embracing their principles, phenomena, and use of the various instruments. Chemistry, mineralogy and geology in all their branches, had been introduced in 1820. Artillery, from a few elements given in a small treatise, with a little target practice and the manual of the piece, had expanded to the theory and practice of gunnery, the fabrication of pyrotechnics required for all the purposes of war, and the maneuver of pieces and foot batteries. Grammar, rhetoric, geography, history, moral philosophy, and constitutional and international law had been added in 1818 to the duties of the chaplain. Engineering, just beginning to be taught as in the Polytechnic School of France, had been enlarged to the broad basis upon which was built subsequently the admirable course of field and permanent fortifications, the science of war, architecture, stereotomy, and civil engineering in all of its branches. Infantry tactics confined chiefly to elementary drills in 1817, comprised in 1833, the theory and practice of all movements from the school of the soldier to evolutions of the line, including the exercises of light infantry and riflemen. Military police, in camp and barracks, was carried out to the full extent required by army regulations. Numerous summer marches had been made, extending even as far as Boston, but were abolished after 1822.

The peerless superintendent was relieved, July 1, 1833, from command of the military academy, which, in the sixteen years of his devoted administration, had grown from a badly conducted rudimentary school to become a pre-eminent seminary of science, and enduring monument of his fame, a fostering mother to the whole army, the cynosure of all educational institu-

tions throughout the land, and a priceless possession for the nation's security and glory.

We have before us, to come down nearer to the present time, the "Official Register of the Officers and Cadets" for 1841, and also a like pamphlet for 1891, fifty years later. The two registers illustrate in a striking way by their substantial identity in form and substance how slight the changes have been in this half century, and how nearly the academy owes its present and permanent form to Col. Thayer only. As the academy is generally admitted to stand at the head of all military schools in many respects, if not in all, no greater evidence of the honor due to him could be desired.

In 1841, with 219 cadets on the roll, the academic staff consisted of 28 members only (apart from the superintendent), and the military staff of 5 officers. The several academic departments were precisely the same as to-day, except that they had then only "teachers" of modern languages and drawing, whereas they now have "professors."

The academy as now organized with 275 cadets on the roll, * is under a superintendent (Col. John M. Wilson, U. S. Engrs.), assisted by an academic staff of 58 members, and a military staff of 7 officers, 3 of them surgeons. The several departments as now organized are each of them under a professor (all, except the chaplain, ex-officers of the Corps of Engineers) and a certain number of assistant professors and instructors, all of whom are officers of the army on detail. The following Table V. gives a list of the several departments, the maximum marking assigned to each department in the merit roll, and the number of instructors in each department. The table, therefore, gives some idea of the relative attention given to civil and military education at West Point. In the table the professor in charge of each department is counted in with the other instructors.

If it be admitted that the relative value assigned to the several studies as a maximum for the examination markings is a fair index of the tendency of a school and of the kind of training a man will get there, it must be admitted that the charge frequently brought against West Point by civil engineers, that it devotes so much attention to military matters as to make it impossible to give a sound training in civil engineering, is far from borne out by the facts. Counting "civil and military engineering" as one study, and that a civil one (which we think it fair to do for reasons we will not go into in detail), the weight given to civil studies as compared with military drill and study is as 19 to 2. Classing in military engineering with military studies, the relation is only as 17 to 4, or perhaps 17 1-2 to 3 1-2. The "discipline" marking, only 10 per cent. of the whole, no one will say is of so little value to a future civilian as to make it fairly chargeable to either division.

The same conclusion is indicated if we compare the relative number of instructors for the several departments. Considering that five officers are needed in the department of tactics to command the battalion of cadets and the four companies thereof, the list given in Table V. certainly does not indicate such disproportionate attention to military matters as to greatly injure the quality of the instruction given in the usual studies of an engineering school, even if the time devoted to military drill and discipline could be regarded as lost, which of course is far from the case. We see no reason to doubt, and we do not doubt, that the same young man entering West Point and any one of our civil engineering schools, and then turned loose to make his own way as a civil engineer after graduation, is as an average of the pros and cons, quite as well fitted to succeed in his profession by the West Point training as by that to be had at any civil school.

It cannot be denied, however, that so far as subsequent career is a fair index of special aptitude and fitness, the graduates from West Point of late years have not shown any special taste for the profession of the civil engineer. This may be illustrated by turning back again to the tables already given (Tables III., IV.), or to the "Official Register" of 1841, to which we have already referred. There were then, as stated, 219 cadets on the rolls. They were of an age to be about 40 when the "late unpleasantness" broke out, and the world has heard from a number of them since as soldiers, or as military engineers, but of not one of them does it know or care anything as a civil engineer. If we ran over their biographies correctly (we hope we have not overlooked any one), only three of them ever attained to the rank of Chief Engineer in civil life, and they of very unimportant railways. Only nine of them ever practiced as civil engineers at all in any capacity or at any time. It is natural that the percentage of famous soldiers should be very large in these classes. Selecting names purely at random, as those which we knew at sight had been honored by much military success, we drew off the following list of 19 men, all of whom rose to high command, and our list omitted at least as many more who rose to the grade of major-general, but did not have the good fortune to make themselves so famous. The list is made out in the order of their standing on the conduct roll, which was then made out each year with the entire body of cadets on one roll, according to relative "demerit." With a demerit of 200 the victim was dropped. We add also, in the second column, the class rank of each man at graduation, and the contrast between the two columns will show that rank in studies and rank in conduct were often two different things. Class 1 was the class of 1841; class 2 of 1842, etc.:

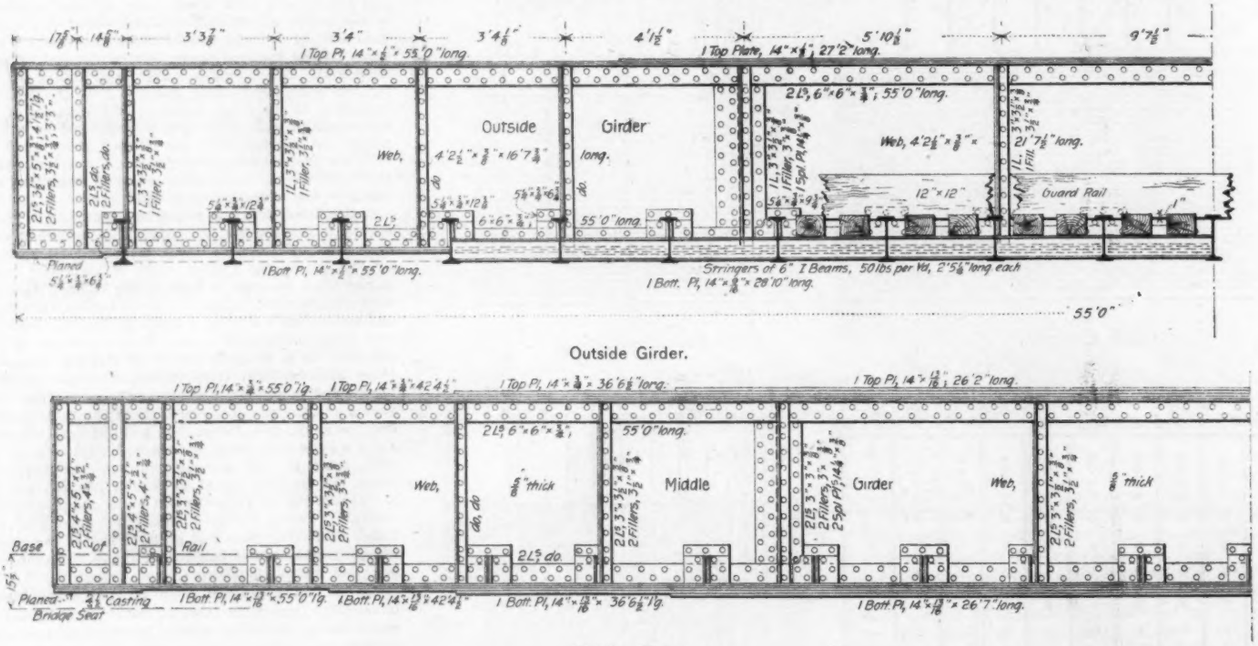
Table V.—Organization of the Academic Departments of the West Point Military Academy, and of the Maximum Marking for Each Department in Examinations.

| Department of | Value in merit roll. | No. of instructors |
|---|---|---|
| 1. Natural and experimental philosophy.. | 300 | 5 |
| 2. Modern languages..... | 300 | 8 |
| 3. Drawing..... | 125 | 4 |
| 4. Mathematics..... | 400 | 9 |
| 5. Chemistry, mineralogy, geology..... | 225 | 5 |
| 6. History, geography, ethics..... | 75 | 3 |
| 7. Civil and military engineering..... | 300 | 4 |
| 8. Law..... | 150 | 3 |
| 9. Practical military engineering.....None | | 3 |
| 10. Military tactics (drill regulations)..... | 100 | 9 |
| 11. Ordnance and gunnery..... | 125 | 3 |
| 12. Master of sword..... | ... | 1 |
| 13. Discipline..... | 200 | .. |
| Grand total.....2,300 | | 57 |
| Total for civil department (Nos. 1 to 8)..1,875 | | 42 |
| " military departments (Nos. 9 to 12) | 225 | 16 |
| " discipline (No. 13)..... | 200 | .. |

(Note.—Last year (1891) a merit value of 45 was given to "Practical Military Engineering," making the present grand total 2,345 instead of 2,300, as shown above.)

| Conduct Rank. | Class Rank. | Name. | Class. | Demerit. |
|---|---|---|---|---|
| 1 | 2 | Horatio G. Wright..... | 1 | 0 |
| 16 | 7 | Thos. J. Rodman..... | 1 | 7 |
| 31 | 11 | Nathaniel Lyon..... | 1 | 12 |
| 39 | 5 | Wm. S. Rosecrans..... | 2 | 13 |
| 47 | 2 | John Newton..... | 2 | 18 |
| 52 | 39 | Geo. Sykes..... | 2 | 20 |
| 56 | 1 | Z. B. Tower..... | 1 | 21 |
| 86 | 11 | S. B. Buckner..... | 4 | 35 |
| 111 | 24 | Abner Doubleday..... | 2 | 46 |
| 115 | 7 | Alfred Pleasonton..... | 4 | 48 |
| 130 | 8 | Gustavus W. Smith..... | 2 | 60 |
| 131 | 1 | Wm. B. Franklin..... | 3 | 60 |
| 144 | 21 | Ulysses S. Grant..... | 3 | 67 |
| 158 | 10 | John F. Reynolds..... | 1 | 81 |
| 165 | 18 | Winfield S. Hancock..... | 4 | 85 |
| 207 | 17 | John Pope ..... | 2 | 158 |
| 211 | 54 | Jas. Longstreet..... | 2 | 164 |
| 218 | 52 | Earl Van Dorn..... | 2 | 192 |
| 219 | 32 | Don Carlos Buell..... | 1 | 193 |

Nevertheless, while the days of drawing heavily upon West Point for civil engineers are long since past, and are not likely ever to return, we believe that this is in no respect because the training there is any less adapted to training good civil engineers than it used to be, or than it now is at good civil schools. The modern tendency to specialization has done its work,


1 Top Pl, 14" × ½" × 55'0" long.
1 Top Plate, 14" × ½", 27'2" long.
Outside Girder
Web, 4'2½" × ⅜" × 16'7⅜"
2L's 6" × 6" × ⅜", 55'0" long.
Web, 4'2½" × ⅜" × 21'7½" long.
12" × 12"
Guard Rail
1 Bott Pl, 14" × ⅞" × 55'0" long.
Stringers of 6" I Beams, 50 lbs per Yd, 2'5⅝" long each
1 Bott. Pl, 14" × ⅞" × 28'10" long.
55'0"

Outside Girder.


1 Top Pl, 14" × ⅜" × 55'0"lg.
1 Top Pl, 14" × ⅜" × 42'4½"
1 Top Pl, 14" × ⅜" × 36'6½" long.
1 Top Pl, 14" × 13/16", 26'2" long.
2L's 6" × 6" × ⅜",
55'0" long.
Web,
⅝" thick
Middle
Girder
Base
Rail
Planed Bridge Seat
1 Bott Pl, 14" × 13/16" × 55'0"lg.
1 Bott Pl, 14" × 13/16" × 42'4½"
1 Bott. Pl, 14" × 13/16" × 36'6½"lg.
1 Bott Pl, 14" × 13/16" × 26'7" long.

Middle Girder.

DOUBLE TRACK THROUGH PLATE GIRDER BRIDGE, IOWA DIV., C. & N. W. RY.; W. L. Stebbings, Engineer.

* The number of cadets authorized by law is 347, but there are always many vacancies caused by discharges, failures to appoint in time, etc. These vacancies are now somewhat reduced by the expedient of nominating alternates.

that is all. There are relatively much fewer opportunities to enter West Point than there used to be, and a multitude of civil colleges which men with no military tastes can enter. That our civil colleges might take some lessons from West Point with advantage, however, we think will appear from the following summary of the course of instruction and the treatment and training of cadets.

We should perhaps add also that a number of the younger officers have recently left the service and are becoming prominent in electrical engineering. Of these we may mention:

Capt. Eugene Griffin, No. 3 in class of 1875.
Lieut. O. T. Crosby, No. 2 in class of 1882.
Lieut. E. J. Spencer, No. 5 in class of 1882.
Lieut. H. I. Hale, No. 1 in class of 1885.

In addition much good work in electrical engineering has been done within the corps by Lieut. John Millis, No. 1 in class of 1881, and others. The same causes which led to the accessions from West Point to the ranks of civil engineers in early days, the sudden creation of a new profession for which adequate special training has not yet been provided, are operating to-day in respect to electrical engineering, though on a smaller scale.

## A THIN FLOOR PLATE GIRDER BRIDGE.

The accompanying engravings give details of one of three plate girders recently designed by Mr. W. L. Stebbings for the Chicago & Northwestern Railway, which will be of interest to our readers by reason of their novelties of construction, especially in respect to their very thin floors. Mr. Stebbings writes us in an accompanying note:

This floor is believed to be as thin as any yet constructed, and in itself has nothing to recommend it. Whenever the exigencies of the case demand, however, it is believed that as regards expense, accessibility for inspection and painting, and in fact for the demands of modern railway traffic, it furnishes much to be desired. These spans were built by the New Jersey Steel & Iron Co., of Trenton, N. J., and were erected by the railway company.

The location at which these girders were erected was not included in the notes sent us. The remaining details of importance are shown with sufficient fullness on the drawings themselves, with one exception, which it would require a plan view to show; The first, fifth, ninth, etc., floor beam has half its top flange cut away in order to enable a plate to be riveted to the web, which plate extends up to the under side of the top chord, as may be seen in the elevations. This practically suspends the floor beams at these points, where the method of support elsewhere used is not easily applicable, for constructive reasons.

## REPLY TO THE ENGINEER'S REPORT ON THE NEW WATER SUPPLY FOR NEWARK, N. J.

In our issue of Feb. 27 we published the report of Engineers A. Fteley and C. E. A. Jacobsen on the reservoirs and capacity of the water supply works built by the East Jersey Water Co., for the city of Newark, N. J. This report criticised some minor points of construction, which, we then stated, will probably be made right before the company asks the city to accept the works; it also stated that the shallow flowage clause of the contract had been entirely ignored, and that the works could not in a dry year furnish the amount of water called for in the contract.

The contract calls for the completion of the works by May 1, 1892, or a penalty of $100 a day until the works are completed. According to the engineer's report the contract cannot be fully carried out until more storage capacity is provided, and until excavations are made to comply with the shallow flowage clause of the contract.

With the above preliminary remarks to aid in understanding the matter, we give below the company's reply to the engineer's report, as submitted March 12 by Vice-President Henry S. Drinker.

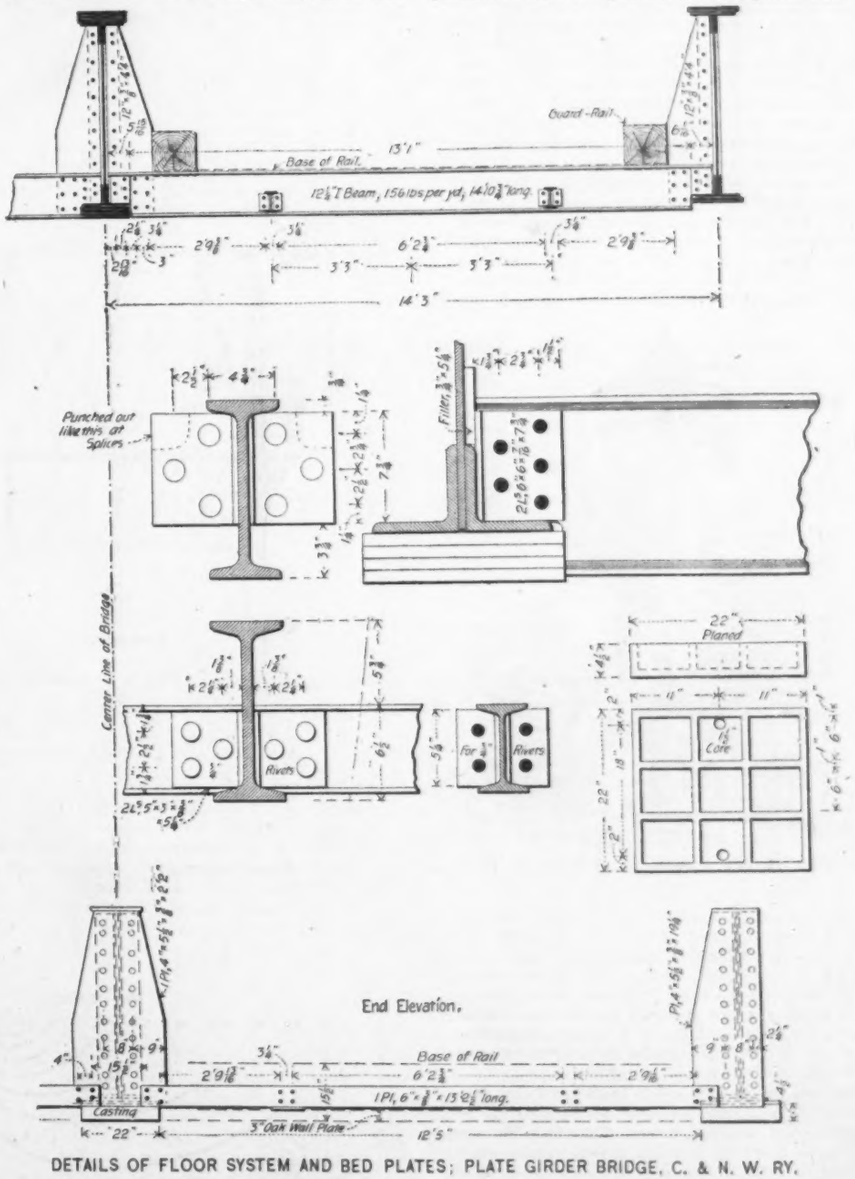
Those wishing further particulars regarding the works in question are referred to Engineering News for Oct. 11, 1890, Aug. 1 and 8, 1892, the article named above in our issue of Feb. 27, 1892, and to correspondence published March 12, 1892.

We print Mr. Drinker's letter in order that both sides of the case may be presented in these columns. The letter was addressed to the Board of Street and Water Commissioners, and is given in full, without further comment, as follows:

We duly received the copy of the report of your engineers, which you were pleased recently to forward us. We do not understand that your communication calls for any reply from our company at this time, except to acknowledge your courtesy in sending it, as we should consider it premature to burden your board with any presentation or discussion of engineering questions prior to the completion of our works, and you will, of course, appreciate that any inspection of the works on your part, prior to such completion, should be made with an appreciation of the fact that the conditions and aspect of the work are changing daily as the task nears its end, and that until it is done, and tendered to the city, we should not be criticised for choosing our own time to carry out plans formulated from the beginning. We, however, desire to state to your board, that the things complained of by your engineers in their report, result largely from the incidental and natural conditions during construction of works of such magnitude as those we are building, and it has been and is our intention to so complete the works, that when tendered to the city, they will be found to be satisfactory and in accordance with the contract, and in this connection we desire to state, very emphatically, that when the reservoirs are ready for delivery, there will be no valid ground for complaint arising from any cause affecting the purity of the water nor do we believe there is any now.

The East Jersey Water Company has as great an interest as the city of Newark can possibly have in the matter, inasmuch as we remain in possession of the works for a number of years, and will be directly interested in the quality of the water furnished, not only to the city of Newark, but to outside parties, and will be equally interested in the matter of the proper capacity of the reservoirs and works, which will be found to have been projected and built on a scale to satisfy every requirement of the contract.

The Croton water supply, for the quarter euding Dec. 31, 1891, was 150,000,000 gallons per day, excepting from Nov. 4 to Nov. 24, when the protracted drought reduced the daily supply to 120,000,000 gallons, after drawing upon all available resources. The average daily supply now received and distributed is 130,000,000 gallons from the new aqueduct, 25,000,000 gallons from the old aqueduct, and 8,000,000 gallons from the Bronx River conduit, or 163,000,000 gallons in total per day. The Chief Engineer of the Croton aqueduct reports that the demand upon the high service is steadily increasing, and 20,000,000 gallons daily are now supplied. This is not enough, and he wants $500,000 to increase this supply. The total number of water meters now in use is 24,264; 380 being added in the quarter. The same report says that the present storage capacity in the Croton watershed is 13,000,000,000 gallons. The completion of the East Branch and Bog Brook reservoirs will add 4,000,000,000 gallons to this, or just equal to the draft upon storage last November. The completion of other basins now under construction or contemplated will raise the total storage to 39,000,000,000 gallons, and the report says that the erection of the proposed Cornell Dam is not now necessary, though it would add 30,000,000,000 gallons to the total above given.




DETAILS OF FLOOR SYSTEM AND BED PLATES; PLATE GIRDER BRIDGE, C. & N. W. RY.

## THE DES MOINES, IOWA, STAND-PIPE.

The stand-pipe for the water-works of Des Moines, Iowa, here illustrated and described from data furnished by Mr. Edward W. Dewey, C. E., is 100 ft. high, 30 ft. in diameter, and is made of rolled plate steel in 5-ft. courses. The lowest course is 7-8-in. thick, and the thickness gradually decreases to 1-4-in. in the top plates. All plates are single-riveted on the horizontal joints, and double-riveted on the vertical joints, except the two lower courses, which are triple-riveted.

A winding stairway of easy ascent leads to the top of the tower, 280 ft. above the city datum of Des Moines. The floor of the observatory thus formed is made of 12-in. I-beams supporting 2-in. plank, and a top flooring of 1-in. hard pine. In the center of this floor is a "well-hole," 4 ft. square, built up 7 ft. 9 ins. above the floor and covered with a galvanized iron wire netting of close mesh. A wrought iron railing incloses the balcony and stairway, both of the latter being carried on brackets of ornamental design.

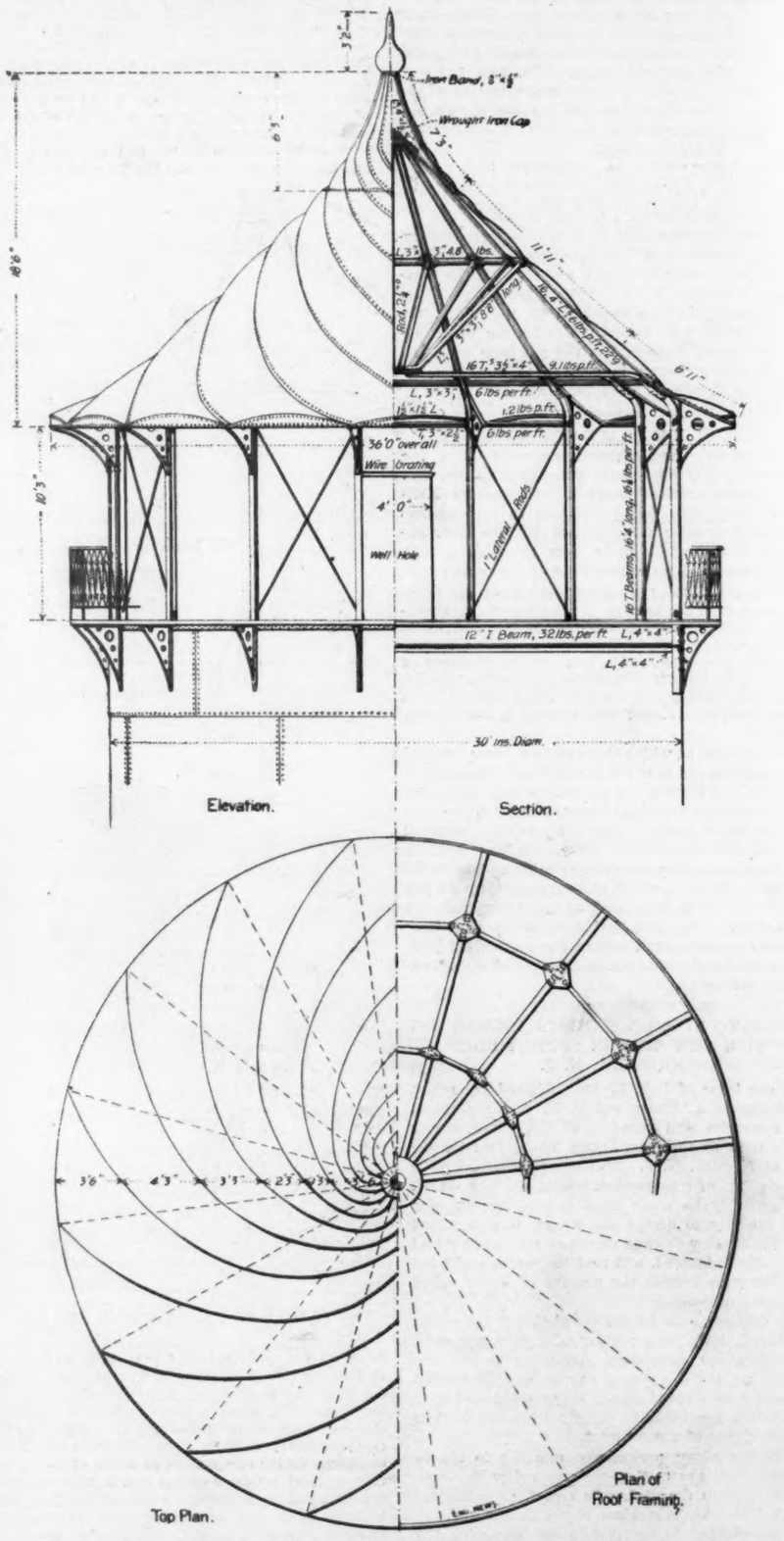
The conical roof of this tower is made of burnished copper, laid in raised spirals on a frame of wrought iron made as shown. The roof is carried on 16 T-beam columns spaced 5 ft. 10 29-32 ins. apart. Every other panel is tied by two 1-in. rods. The copper is No. 20 and weighs 1.15 lbs. per square foot; all sheets are brazed together, properly stiffened with straps, and the whole riveted to the iron frame in spiral courses, as shown. To lessen the effect of the wind acting from beneath this roof a ceiling of neat design, made of No. 20 corrugated iron, was riveted to the horizontal radial braces. This stand-pipe was designed by Mr. Chester B. Davis, M. Am. Soc. C. E., of Chicago, the Chief Engineer of the works, and was made by the Porter Boiler Works, of Chicago, as contractors.

Standpipe at Des Moines, Ia.; Chester B. Davis, Engineer.

The erection of a stand-pipe is an interesting feature of its construction seldom dilated upon in descriptions of similar work. This Des Moines stand-pipe was built in a cold winter, without scaffolding or false works, and at an extremely low cost. The plan of erection here to be described was devised by Mr. D. J. Lewis, Jr., who had charge of the work for the contractors. A similar plan, however, was used, in 1883, in erecting the stand-pipe at Atlantic City, N. J.

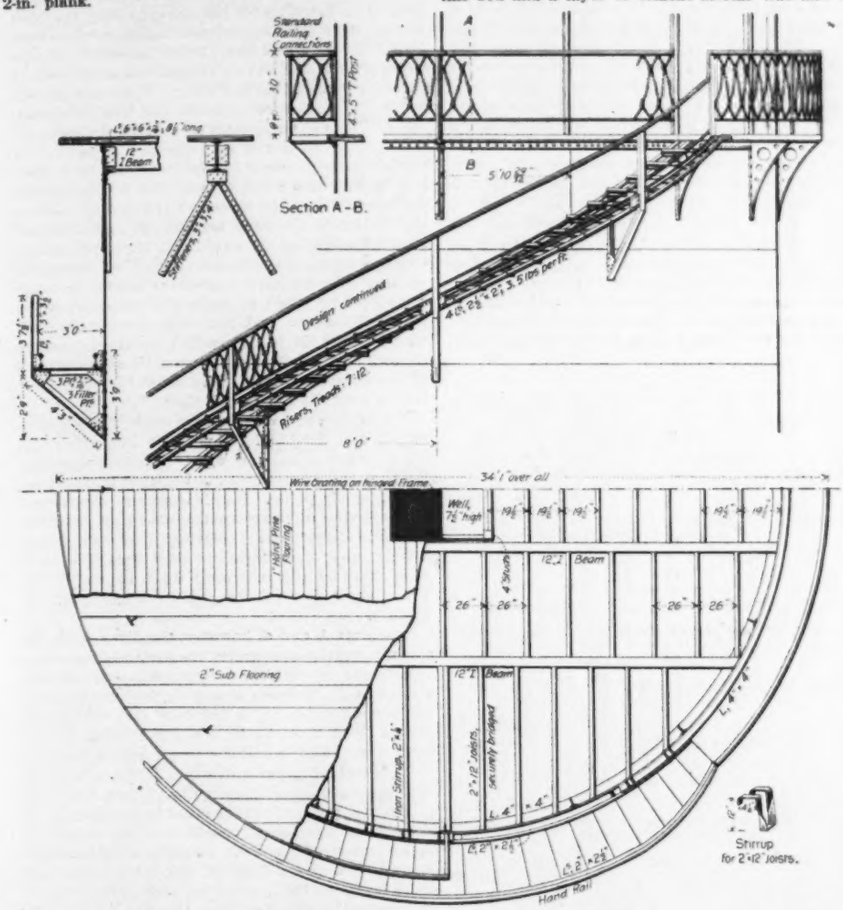
A "floating platform" was used inside the cylinder and two cages of light iron were swung outside, and from these all erection and riveting was done. The "float" was 29 ft. 9 ins. in diameter, or 3 ins. less than the inside diameter of the stand-pipe. It was made of a frame of 12 by 12 in. timbers, to increase its buoyancy, and covered with two layers of 2-in. plank, all so bolted together as to be easily taken apart after it was no longer wanted. The float was anchored by chains leading from ring-bolts in the wooden frame to lugs on the pipe.

In the center of the float was a derrick with a 12-ft. mast and a boom 25 ft. long. At the top of the mast was a band provided with three eyes; one of these eyes carried the topping-lift of the boom, and the other two were for the leaders of the hoisting fall, which were shifted from side to side as the plates were put on. On top of the mast was a plate carrying eight guys, of which six were always fastened to the edge of the stand-pipe to overcome the tilting of the float while hoisting and placing a plate. The hoisting rope passed from the masthead to a bracket at the edge of the stand-pipe, and thence to a hoisting engine on the ground below. On the float were the forges, riveters and helpers. Including the two riveters in the cages outside, eight men and two boys made up the entire force, and though the work was done in September and January they riveted



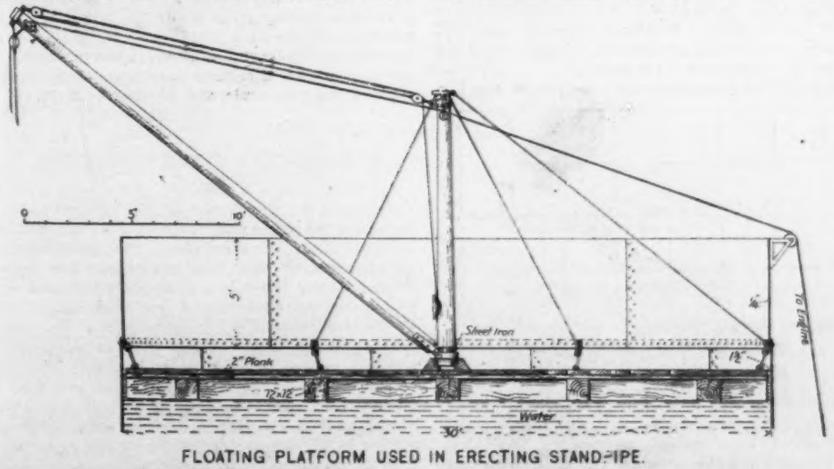

DETAILS OF ROOF OF STANDPIPE FOR NORTH DES MOINES WATER CO.

and calked a complete course or ring of the stand-pipe in 15 hours. The cages shown in the illustration were made of light angle iron and floored with 2-in. plank.




DETAILS OF FLOOR, STAIRWAY AND RAILING.

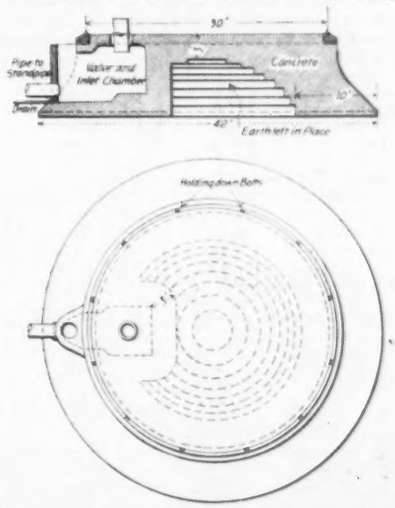
To insure the working of this floating platform it was first necessary to secure a perfectly tight first course to the stand-pipe. After the masonry was completed and the valves, inlet and blow-off pipes set and tested, the bottom was bolted together on supports on the platform, the angle irons put on and the first course of plates all riveted and calked. This first section was then filled with water and tested and all leaks again calked. As the area was too large to use wet cement between the bottom of the stand-pipe and the masonry base, the following plan was adopted: This bottom was set in November in somewhat damp weather. The foundation was first washed off with water and two inches of dry cement and sand were evenly spread over it and made level with a sweep-board. The stand-pipe bottom was then lowered to within 3 ins. of this bed and a layer of cement mortar was laid in a 6-in. ring, 3 ins. thick, around the edge and under the rivets of the outside angle iron ring. The bottom was then lowered on the foundation. The dry cement and sand absorbed sufficient moisture from the wet foundation to set it perfectly. Eight 2-in. holes had been bored in the bottom to introduce thin grout if this were found necessary; but in three hours the cement and sand under these holes were damp enough to insure setting without the grout. These holes were afterward plugged with iron.




FLOATING PLATFORM USED IN ERECTING STAND-PIPE.

When the bottom course was finished the floating platform was put together inside, the plates for the next course were hoisted up and bolted on and the cages were hung in place, and the plates then riveted and calked. Then by means of a hose connected with the city main water was poured into the then completed portion of the stand-pipe, and the float lifted sufficiently high to put on the third course. This operation was repeated until the top course was in place and the posts for the roof and the angle iron for the floor were riveted. The float was then taken apart and sent to the ground, after which a temporary workin floor was put in at the top. The regular floor-beams were then set.

It was at first intended to let the float gradually sink as the water was let out and use the platform for riveting on the brackets for the stairway. But it was found that a ring of ice had formed inside the stand-pipe, 18 ins. thick on the north side, but only 2 ins. thick on the south side where it was exposed to the sun. The stairway brackets were riveted from a raft which was also used to cut away the ice. The inside was given two coats of black asphaltum; the outside of the stand-pipe was painted a steel color, and the stairway and railing black. There was no accident of any kind during construction.




Section and Plan of Foundation for Des Moines Standpipe.

Another interesting feature of this structure is its foundation, shown here in section and plan, and this foundation is of concrete, made of 1 part domestic cement, 2 parts clean sharp sand, 2 parts screened gravel and 1 to 2 parts of broken stone. It was put in place in 8-in. layers and thoroughly rammed until the water flushed to the surface. In excavating for this foundation in a very hard, tough clay, perfectly dry, a core of earth, shown at A, was stepped off and left in position, as shown. This saved about 80 cu. yds. of concrete. This earth being confined must support the weight above it. In case any settlement occurs, the foundation may act, partially, at least, as a dome. There is such an excess of section of the concrete, however, in order to reach proper depth and material for the bottom of this foundation, that it is obviously safe. Mr. Davis has used this plan of foundation under several large stand-pipes, and the results are perfectly satisfactory.

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The total population of the earth is placed at about 1,480,000,000 by "Die Bevoelkerung der Erde," just issued. It divides this population as follows: Europe, 357,379,000; Asia, 825,954,000; Africa, 163,963,000; America (North and South), 121,713,000; Australia and Tasmania, 3,230,000; the Oceanic Islands, 7,420,000, and the Polar regions, 80,400. Belgium is the most densely populated country, with 533 per square mile. The Netherlands follow with 355; Great Britain and Ireland, 319; Italy, 270; the German Empire, 223; Switzerland, 184; France, 123; Servia, 116; Roumania, 97; Spain, 88; Greece, 87; European Turkey, 82; European Russia (without Finland), 48; Sweden, 27, and Norway has 14 persons per square mile. In Asia, 489 per square mile is the average; Japan has 270; China proper has 231, and British India 195. The United States is variously credited with from 18 to 21.5 per square mile; Mexico and Central America with 15, and the South American states range from 10 down to 2.5 per square mile.

## EXPERIMENTS ON THE EFFICIENCY OF WORM GEARING.

By Bertram P. Flint, Pencoyd, Pa.

The following experiments had their origin in the difference which was noticed between the running of the worm gear in two Newton milling machines, one having a single-thread worm, the other a double thread. The machines had 30-in. saws and were used for cutting iron and steel bars accurately to length. The single-thread worm ran at about 500 revs. per minute, and heated considerably. The other worm ran cool at somewhat more than half the above speed-thus giving a greater speed to the saw, as there was no difference of gearing between the worm and the saw in the two machines. The necessary reduction for the double-thread worm was obtained by reducing the belt velocity. A new double-thread worm was ordered to take the place of the single-thread, and before putting it into the machine it was used in these experiments. The single-thread worm, when removed from the machine, was also experimented upon, the unused side of the teeth being brought into action. The third worm and wheel had been in service for a short time in a planer. Each worm was of tool steel, hardened, and each wheel was of cast-iron.

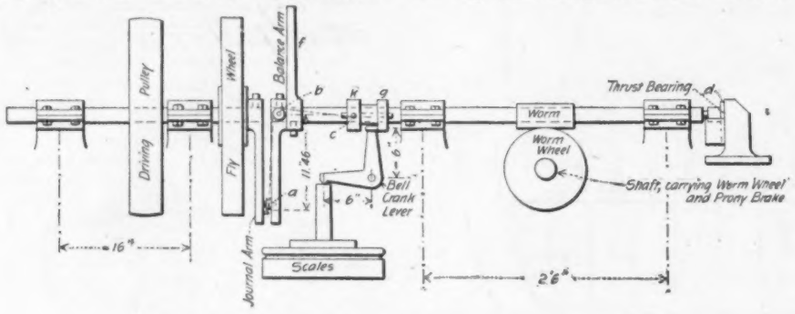


FIG. 1. WORM SHAFT AND TRANSMISSION DYNAMOMETER.

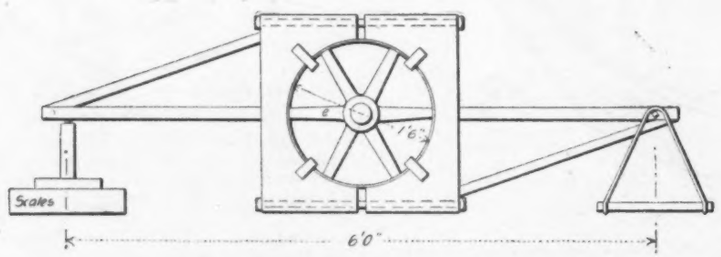


FIG. 2. PRONY BRAKE ON WORM WHEEL SHAFT.

The apparatus used in the experiments consisted of a transmission dynamometer for measuring the power communicated to the worm shaft, and a Prony brake for measuring the power given off by the worm wheel shaft. The former quantity exceeded the latter by the amount of power absorbed by the friction of the worm and the bearings of the two shafts. The whole mechanism was mounted on a substantial timber frame.

Referring to the sketch (Fig. 1), the driving shaft is seen toward the left, driven by a pulley, and having on it, beside, a fly wheel and arm. The arm has on its extremity a stud, and rotation is communicated to the worm shaft by a flexible cord which passes from the stud over the pulley (a), which is on the extremity of a similar arm on the end of the worm shaft, thence over the pulley (b), finally attaching to the pin (c). The other arm (f) is added merely to balance the centrifugal action of the opposite arm at high speeds. The pin (c) screws into the sleeve (k), and enters the keyway shown in the shaft. Thus the sleeve is free to slide along the shaft, but must revolve with it. On the end of the bell crank lever (l) will be seen a small wheel which revolves by contact with the inside of a groove cut in the sleeve. The pull on the stud necessary to cause rotation is transmitted through the cord and lever to the scale, and there weighed. This pull multiplied by the distance of the center of the stud from the center of the shaft (which of course was made equal to the distance from the outside of the pulley (a) to the shaft center plus one-half the diameter of the cord, gives the turning moment. The constant jar when the machine was in motion prevented the friction of rest in the bell crank lever and sleeve. The device was sensitive to a very small change of load, or a difference of a half pound on the scale. The worm and wheel shafts ran in ample bearings. The bottom of the wheel dipped in oil, and the end of the worm shaft ran in oil which was contained in a tin box. The groove cut near the end of the shaft allowed immersion of the same to a depth of ¼ in., so the lubrication was very satisfactory. A phosphor-bronze plate (d), against which the shaft turned, communicated the thrust to a rigid part of the frame.

Besides this transmission dynamometer another dynamometer was necessary to absorb the power. It consisted merely of a Prony brake (Fig. 2) made of wood, as strong and light as possible. The twisting moment was determined by the push on a small platform scale on one side, and a weight suspended from the other arm. The weight was increased until the push became equal to the pull. Thus there was a couple acting which relieved the bearing of the friction which would have been caused by an unbalanced force.

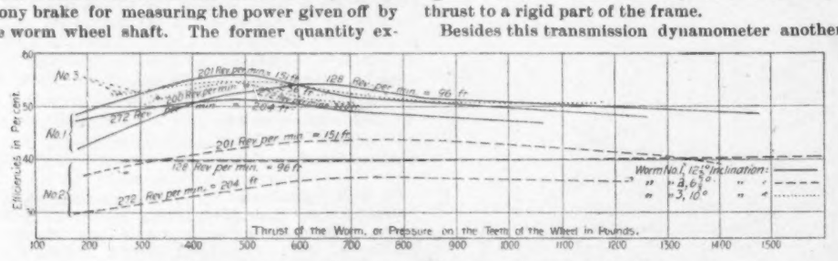
No. 3
No. 1
No. 2
Efficiencies in Per cent.
Thrust of the Worm, or Pressure on the Teeth of the Wheel in Pounds.
Worm No. 1, 12½° inclination:
" " 3, 6½° " "
" " 3, 10° " "

FIG. 3. DIAGRAM OF EFFICIENCIES OF WORM GEARING.

(On each curve are given the number of revolutions per minute of the worm and the corresponding velocity of its sliding surface in feet per minute.)

In experimenting, the apparatus was started with a light load and readings of the dynamometers were taken. The load on the transmission dynamometer was then set 5 lbs. ahead and the scale beam made to balance by screwing up the brake. Thus the load was successively increased and readings taken each time until the worm wheel began to smoke. It was deemed inadvisable to go beyond this on account of the danger of cutting the worm. When the gearing cooled the tests were repeated and the data averaged. The pull on the arm of the transmission dynamometer necessary to keep the apparatus in motion with the brake removed varied from 3 to 3¼ lbs, in different experiments, and a considerable portion of the power absorbed is evidently due to the friction of the four bearings (s), (s), (s), (s), and the thrust bearing (d). In plotting the curves shown in Fig 3, representing the efficiencies, no deduction was made for the friction of these bearings, hence the efficiency given is really the efficiency of the whole mechanism and not that of the worm and wheel alone. It is this which in large measure accounts for the fact that the efficiencies obtained are much below those usually found for worm gearing in experiments of this class.

Comparison of the curves for worm No. 1 (double thread and 12½° inclination), with those for worm No. 2 (single thread and 6½° inclination) show how faulty was the old fashioned method of designing this class of gearing. The aim formerly was to keep the obliquity of the worm threads small, requiring thereby a larger diameter of worm. If any advantages are gained by the greater diameter it would be more than offset by the increased work of driving the worm shaft due to the greater moment of the friction.

In worms 1 and 2, however, the diameter is the same, hence the lever arm of the frictional resistance is the same, worm No. 1 having nearly twice as steep a pitch as No. 2, shows about 10% higher efficiency; the reason, evidently, is the fact that with worm No. 1 a given rotation of the worm wheel is performed with hardly half the linear motion between the surfaces of worm and wheel which is required with the worm of small obliquity. Worm No. 3 was of larger diameter than the other two, and running at the same number of revolutions per minute it began to heat with a much smaller load than either of the others. In the diagram, Fig. 3, the end of each curve indicates the limit of capacity of each worm, an increase of speed or load above this point will result in cutting. Of course the condition of the rubbing surfaces is an important factor in determining this point of maximum pressure as well as the efficiency. All gearing having rubbing surfaces should receive the most perfect lubrication, an oil bath being the best method.

The curves of efficiency indicate that double-thread worms attain their highest efficiency with loads of 500 to 600 lbs. The single thread worm shows the best results with a load of 700 to 800 lbs.

The horse power given out by the worm gearing corresponding to these points may be readily computed by multiplying the given thrust pressure by the circumferential velocity per minute of the worm wheel at its pitch circle, and dividing by 33,000.

## WORLD'S COLUMBIAN EXPOSITION.

### Fuel.

Proposals for the supply of fuel for generating steam for the power plant were received last month by the Bureau of Construction. The specifications called for 60,000 tons (delivered in nine lots from June, 1892, to November, 1893) of bituminous or anthracite coal, screened and free from dust, slate or other impurities; an analysis of the coal and guaranteed percentage of ash to accompany each proposal, as well as 5 lbs. of the coal as a sample. Bituminous coal to be of the size known commercially as No. 2 nut, having passed through a screen having meshes 1-in. square onto a screen having meshes 1-2-in. square. Anthracite coal to be of the sizes known commercially as chestnut or buckwheat. For oil about 180,000 barrels would be required, taking 3 barrels of oil or 126 gallons, as equal to 1 ton of coal. The oil to be delivered in the exposition tanks at Jackson Park, and 1 gallon of oil to be sent with the proposal as a sample of quality. The proposals were as follows:

| | Per ton. |
|---|---|
| Weaver, Getz & Co., Shawnee coal, No. 1 and No. 2 nut, screened | $2.44 and $2.34 |
| Rhoads & Ramsey Co., Little Muddy lump, 1 1-4 in. screen | 2.60 |
| New Pittsburg Coal & Coke Co. | 3.08 |
| Silver Creek & Morris Coal Co., No. 2 chestnut, anthracite, during 1892 | 3.95 |
| Standard Oil Co., oil in 42-gallon barrels during 1892 and 1893 | 70 and 72 cts. per barrel. |

The contract was awarded to the Standard Oil Co. at the prices of its bid, and it is estimated that about 750 bbls. per day will be required when the exposition is open. The total quantity of oil, 180,000 bbls., at 72 1-2 cts. per gallon, will cost $130,500, while the lowest bid for the 60,000 tons of coal, $2.38 per ton, amounted to $142,800.

As of interest in this connection we give below an extract from the remarks made by Mr. A. Sahlin, in a discussion by the American Institute of Mining Engineers, in 1891, on the subject of the preparation and utilization of small sizes of anthracite. No reference, however, is made to the question of smell from the oil used, either near the tanks or furnaces:

About a year ago I made a test, to determine the economy of substituting bituminous coal as fuel, for crude oil or anthracite screenings (below the size of pea coal). In determining such a matter, the size of the plant is of importance, and also the question, whether it is to be run continuously, or in the day time only. There are also numerous local conditions to be considered. The plant in this case was required to evaporate, per hour, 36,000 lbs. of water to steam of 80 lbs. pressure. It comprised a number of tubular boilers 72 ins. in diameter, 20 ft. long, with 56 steel tubes, 4 ins. in diameter, furnishing a heating surface of 1,388 sq. ft. per boiler. The boilers were fitted with McClave grates for hard coal firing, and ordinary double grate-bars for burning soft coal; and, where oil was utilized, the grate was covered with a double layer of firebrick, and a checker-work of firebrick was arranged across the grate, at a distance of about 2 ft. 6 ins. from the point of the burner. The grate area was 30 sq. ft. The pipe connecting the boiler with the smokestack was brick lined, and 29 ins. diameter in the clear. The boilers were coupled in pairs to brick lined iron smokestacks, 95 ft. high, and 47 ins. diameter in the clear. Unfortunately, no means were available for determining the temperature of the escaping gases in the stacks. Feed water was supplied to the boilers at from 68 to 70 degrees F. In computing the tests, the temperature of the feed water is uniformly assumed to have been 212 degrees F., and corresponding corrections were in each case made. The test lasted ten hours. This may seem a very short time, but as so many contributing factors had to be purely assumed, it was considered long enough for arriving at a conclusion sufficiently correct.

When firing coal, the grates were throughly cleaned once during the ten hours of the test, precisely as would have been the case in ordinary practice. Crude Lima oil was supplied under a uniform pressure of 20 lbs. per sq. in., and enough oil was fed to fill the combustion chamber without unduly straining or crowding the boiler. The prices of fuel were assumed to be: oil, 2.06 cts. per gallon; bituminous coal, $2.65 per ton; anthracite screenings (all below pea), $1.25 per ton, all delivered in the boiler house. The test gave the following figures, which were used as the basis for estimates of economy:

Performance of Tubular Boiler.

| | Crude oil. | Bituminous coal. | Anthracite screenings. |
|---|---|---|---|
| Duration of test | 10 hours. | 10 hours. | 10 hours. |
| Amount of fuel burned | 4,746 lbs. | 7,120 lbs. | 4,725 lbs |
| Value of fuel burned | $13.41 | $9.26 | $2.95 |
| Total water evaporated | 60,913 lbs. | 47,206 lbs. | 22,562 lbs. |
| Water evap. per sq. ft. of heat. sur. per hour | .388 lbs. | 3.400 lbs. | 1.625 lbs. |
| Actual average steam pressure | 67 lbs. | 65 lbs. | 66 lbs. |
| Average temperature of feed water | 68 deg. F. | 68 deg. F. | 70 deg. F. |
| Equivalent amount evap. from 212 deg. F. to 80 lbs. steam per lb. of fuel | 15.15 lbs. | 7.87 lbs. | 5.53 lbs. |
| Cost of fuel per lb. water evap. | 0.0220 ct. | 0.0196 ct. | 0.0131 ct. |
| Cost of fuel for evap. 360,000 lbs. of water to 80 lbs. steam | $79.20 | $69.56 | $47.16 |

As a first conclusion to be drawn from these figures, it was shown that, to evaporate the 360,000 lbs. of water required, it would be necessary to operate: with oil, 6 boilers; with bituminous coal, 8 boilers; with anthracite screenings, 17 boilers

The number of men and cost of labor for operating this number of boilers during ten hours would be:

| | Wages. | Per day |
|---|---|---|
| For oil, two water tenders | $1.80 | $3.60 |
| For bituminous coal, two water-tenders | 1.80 = $3.60 | 9.80 |
| For bituminous coal, four firemen | 1.55 = 6.20 | |
| For anthracite screenings, four water-tenders | 1.80 = 7.20 | 2.15 |
| For anthracite screenings, nine firemen | 1.55 = 13.95 | |

Making allowances for depreciation, interest, insurance, etc., in proportion to the size of the plant actually in use, the following table was constructed; showing the economical results obtained from the use of different fuels in a boiler-plant, with an evaporative capacity of about 36,000 lbs. of water per hour during ten hours:

| | Crude oil. | Bitum. coal. | Anthra. coal. |
|---|---|---|---|
| No. of boilers in operation | 6 | 8 | 17 |
| Actual value of fuel consumed | $79.20 | $69.56 | $47.16 |
| Cost of labor | 3.60 | 9.80 | 21.15 |
| Depreciation, interest, insurance on plant at 15 per ct. | 9.00 | 12.00 | 25.00 |
| Repairs, in. grate-bars (assumed) | 1.00 | 2.00 | 4.00 |
| Total cost per day | 92.80 | 93.36 | 97.71 |

Besides the slight advantages which the above table indicates for the use of oil, there are others, which cannot be readily put in dollars and cents; the principal being, that the moment the steam is not required, the oil can be shut off, and all waste of fuel stopped. In burning coal, steam is generated for at least two hours after the machinery is stopped for the night, and the fuel on the grates is burnt for nothing. In spite of these advantages, it was concluded that there would not be enough saved to justify the construction of tanks for the storage of the oil, the installation of pumps, distributing-pipes, etc.; and bituminous coal was settled upon as practically the best fuel for the plant in question.

## THE COMPARATIVE MERITS OF VARIOUS SYSTEMS OF CAR LIGHTING.

### XV.

[A reference list to the prior articles of this series, with the subject of each, was given in our issue of March 19, p. 270.]

### THE COMPARATIVE SAFETY OF GASOLINE CARBURETERS.

Compared with the range of experience with oil lamps or compressed gas, that with gasoline carbureters is as yet limited, if reduced to a common standard of car-years. Several thousand car years of experience have already been had with this plant, however, and the record of accidents of any moment from its use is as yet short, and does not include a single death or serious injury to persons to our knowledge.

A wreck at Thaxton's, Va., on the Norfolk & Western R. R., July 2, 1889, clearly demonstrated that fire would not cause the carbureters to explode if the safety valve remained open. A fire was started from the locomotive nearly an hour after a serious derailment. Part of the wrecked train was burned up, including a car lighted with five carbureters. When the fire reached them they burned like so many torches, or as in the fire tests described in our issue of May 16, 1891, and in no way added to the seriousness of the catastrophe. The carbureters were so little injured that it was not unreasonably claimed that they could have been refitted and applied to a new car.*

The most serious accident known to us which was really chargeable to imperfections of the carbureter light was the burning of a car in service on the Central R. R. of Georgia, May 4, 1891. We have made careful inquiries in all directions as to the real facts of this disaster, which seems to us to have arisen from a heretofore unsuspected form of danger, below explained, and the following appear to be the facts, as nearly as it is now possible to ascertain them:

The Central R. R. of Georgia had caused three new cars, which the Ohio Falls Car Co., of Jeffersonville, Ind., were building for it, to be fitted with the Frost light (three lights to each car). This was applied under the direction of the manufacturers, who also sent a man to Georgia to instruct an employee in the care of the lamps. The latter is admitted to have discharged his duty properly, or at least, no charge of carelessness was made against him, and he was retained in the company's service. The cars had been running between Savannah and Atlanta about one month when the accident occurred. The most authoritative record of the facts which we have is as follows:

The car was charged [at Savannah] on May 2 and went to Atlanta that night, returning the following night. On both trips the lamp after burning awhile began to flame up and was extinguished. On the night of 2d, it burned three or four hours. On the next trip from Savannah [May 4, the night of the accident], without additional charging, it burned for an hour or so in shed, but after getting a few miles on road, began to flare up and was put out. After being put out the globe began to fill with gasoline, and when the porter went back to fix it he reported the globe to be quite full and very hot. He put his lamp on the floor and proceeded to empty the globe. The gasoline fell on the lamp and ignited, and the car was at once on fire beyond control. These were the facts as brought out on investigation. The lamp was evidently overcharged, and had an expert been on the train on the two previous trips, he would have evidently detected the cause and remedied the trouble. What has never been explained is: Why did the globe fill with gasoline after the flame had been extinguished? and why did this not happen on the first night? I would have doubted the fact of its so filling after being put out, had not the testimony been so direct on that point. Judging from condition of carbureters on the remaining cars, there could not have been a very great excess of liquid in carbureter, and as gas is drawn from top of the carbureter, the liquid must have boiled up and primed over, or a leak must have started in the bottom. As the car was completely destroyed, no evidence was left as to any structural defects in that particular lamp and carbureter.

Another equally authoritative account, and in some respects more detailed, is that when the lamp was seen to be behaving badly, a few miles out of Savannah, and a smell of gas attracted attention, the passengers called the conductor, and he closed the needle valve and went forward through four cars to find the porter. The porter found some accumulation of gasoline in the globe, though the needle was closed, and he then went forward again to get some waste, carrying his lantern with him. On returning he placed his lantern on the floor at some distance from the imperfect lamp (claiming that he had had prior experience with the lamp, and that he knew and appreciated the treacherous nature of gasoline) and opened the globe to wipe it out, having no match or fire about him. As he did so he was enveloped in flames, and was somewhat badly burned, but stopped to pull the bell rope. The passengers were watching him, and all escaped without injury, and the conductor, who also had warning, quickly took the necessary steps to cut the burning car free from the train, which stood on the track till the car had burned out (there being three sleepers behind the car). The train then coupled up and proceeded, the trucks of the burned car being thrown off the track.*

These facts seem to us to indicate that the primary cause of the disaster was that one of the three lamps had not been burned for the two preceding nights, causing a distillation of gasoline from the lighted to the unlighted carbureters, with or without some aid from a leak in the upper part of the carbureter. There can hardly have been a leak in the lower part,

* Mr. R. B. Claxton, foreman of the jury which investigated this disaster, gave us, on request, the following summary of the jury's view of the facts, under date of Liberty, Va., Sept. 3, 1889:

"From the evidence adduced it was shown that the train at time of accident was running at a very slow rate of speed, and that the engine had passed nearly over the fill when it gave way. At time of the fire the pilot of the engine was up near the track, on the east side of the washout, the engine resting against the bank. The cars following fell into the washout, some of them being below the engine, when the coals from the firebox fell on the timbers of the cars and caused the fire. It was ½ hour to 1 hour after the accident before the fire was discovered. From the best of my recollection the washout was about 28 ft. deep and 80 ft. wide.

* The newspaper accounts of this disaster were given in our issue of May 6, 1891. The following is an extract from the official report of the Superintendent of Motive Power to the General Manager: "Regarding burning of passenger coach of this road, lighted by Frost system, on May 4, 1891, conductor and porter said rear lamp in coach did not work well before leaving Savannah. When about four miles out it went out, and remained out for some time, when odor of escaping gasoline attracted attention of some of the passengers; when one of them went forward and notified the conductor, who closed needle valve on lamp, and went to baggage car and instructed porter to light it. When porter arrived he found quite an accumulation of gasoline in globe, and tried the needle valve and found it closed. He returned to baggage car for some waste cotton to absorb the gasoline, and on his return found the globe half full of this liquid. Before reaching the lamp (knowing the dangerous nature of gasoline, having had experience with it on other roads), he took the precaution to set his lantern down on the floor in the center of the car. The moment he opened the globe, the confined vapor escaped and ignited, and he immediately was enveloped in a sheet of flame. The coach was standard 50 ft., and had three of these inverted lamps." In the minor details wherein this account differs from the above it is probably less accurate, being of earlier date.

or the accident (or trouble of some kind) would have come sooner.

On Aug. 30, 1891, an incident of some significance, which fortunately did not result in accident, happened to the private car of Senator Calvin S. Brice, President, Lake Erie & Western R. R., which was lit by five Frost lamps. At St. Paul, Aug. 28, Porter Young had filled the carbureters, using about 10 gallons of gasoline. He had to use a "gravity lighter than 86°"; he thinks 4° or 5° lighter. [The standard is 88°.] The next two days were bright and very warm, but the interior of the car was probably cool, the porter thinks from 65° to 70°. The porter could not say whether he filled the carbureters too full or not. At Chicago, on the evening of the 30th (Sunday), the car was standing in the yard, and the porter was alone. He had not lighted the bedroom lamp, but thought he would light it, as all the other cars around were lighted. On opening the valve of the lamp, instead of gas, liquid gasoline issued at the rate of two drops per second, the porter thought, and caught fire as it came out, falling to the floor and not into the glass globe, as that was lowered. About 1½ tablespoonfuls, he thought, ran out. He immediately turned off the cock and blew out his match as soon as he saw gasoline was issuing and did not again attempt to light the lamp.

About two years since a new day coach which was being built at Pullman, Ill., for the Union Pacific Ry., equipped with carbureters was reported to be destroyed by fire caused by gasoline, but just how we have not been able to learn, if, indeed, the precise cause is known. In regard to this incident, and their experience generally with carbureters, Mr. J. H. McConnell, Supt. M. P. and Mach., U. P. Ry., writes us under date of Jan. 19, 1892:

We have some 40 cars equipped with carbureters. As to the matter you asked about—car being destroyed by fire at the Pullman works from use of carbureters—am unable to give you any information, as we have no record of it here. Inexperienced persons handling the carbureters, by turning the valve open too wide, have caused the head lining of the car to be smoked on several occasions.

We experience more difficulty from carbureters in cold weather than at any other time, as they do not burn well, from the fact that the gasoline becomes chilled and does not vaporize readily. In extremely cold weather we find it difficult to make the lights burn. We have tried to overcome this by numerous experiments, but so far have not succeeded in making a good light when the weather is below zero. In warm weather the light has given us good satisfaction.

On Feb. 20, 1891, a parlor car on the Chicago & West Michigan Railway was slightly damaged by a fire originating, it is supposed, in overcharging of one of the carbureters. The facts of this occurrence, we are advised by the superintendent of motive power, were as follows:

We had four cars equipped with the dry carbureter system, and on Feb. 20, last, our parlor car No. 6 was slightly damaged by fire, originating from one of the lamps which had been overcharged with gasoline. There were seven panels of headlining ruined, the varnish of the clear story blistered and a few deck lights broken. The lamp and carbureter were not injured, except that the globe was broken. The responsibility for this accident is wholly charged to one of our employees, who neglected to follow his instructions in charging the carbureter. I might say, in connection with the subject, that this slight fire, while not directly chargeable to the device, resulted in considerable prejudice on the part of those who do not understand the principle of the light, and we have removed the same from the car and replaced with Acme burners (oil lamps). This, I think you will appreciate, is on my company's part in the direction of overcoming a public sentiment that frequently necessitates a change of some kind to allay prejudices, which, at some future period, might be somewhat to our disadvantage.

Another prominent superintendent of motive power, who has had a good deal of experience with carbureters, writes us:

"We have not had any trouble with carbureters, excepting that when we first commenced using them on one or two occasions the carbureters were overcharged. This allowed under some conditions liquid gasoline to go through the burner in place of gas. It would result in an occasional big blaze of light (flame) which was startling to occupants of the cars, to say the least of it. Now that we know of this difficulty there is no more trouble from it."

On the other hand, General Manager Ainslie, of the Wisconsin Central lines, writes us:

"We have two trains equipped with the carbureter lighting system, which have been in service for nearly two years. We have had no accidents, and our experience with the latter system indicates that it is a safe light to use."

The Pennsylvania Railroad, which has had by far the longest and widest experience with this lamp, has had no accidents from its use, and no misbehaviors of the lamp threatening accident, so far as we know or can learn by careful inquiry, except the following: In one case the globe of a lamp in service became filled with flame, and the attendants knocked the lamp down with an axe. In another case the globe became filled with flame but the lamp was extinguished without resort to such extreme measures. Also, about a year ago, a car at the Jersey City yard was about to be charged, and six 2-gallon cans were standing by for charging it, when fire was started in some way never accurately determined, and communicated at once to the car, which, however, was not entirely destroyed. After the fire the cocks of the six charging cans were all found to be open, and it is inferred that vapor was escaping from them and was by some means ignited.

Several other alleged instances of trouble from the plant on various roads have been reported to us and inquired into, but they have always proved to be without known foundation. Having made every effort to collect all reports of casualties from this as from other systems of car lighting, no authenticated records except those above noted have reached us.

On the other hand, during the period covered by our investigations, numerous reports illustrating the damages of gasoline in an unconfined fluid form have reached us. We will quote only two, one a railway disaster and one a house disaster.

On April 14, 1891, a broken journal on a Great Northern Ry. train near Rothsay, Minn., caught in the ties of a trestle, and threw a whole train into the ravine, except the engine and three cars. Among the wrecked cars was one car of gasoline, which was ruptured, and the vapor of the gasoline reaching up to the engine firebox (as was supposed) and carrying fire from it back to the wreck, instantly set the whole train and trestle on fire, causing a loss (by newspaper reports) of some $100,000.

On March 7, 1891, a St. Louis lady, who was housecleaning, tired of dipping out gasoline slowly for cleaning some tapestry curtains hanging between two rooms, poured a quantity of gasoline (one account says two gallons) into a tub or basin, and proceeded in her work. She spilt a little on her dress. She had hardly begun work when fire was carried to her dress from a stove in one of the rooms. She rushed screaming from the room, but was prostrated by an explosion at the front door, where her burning garments "burned a great scar on the hall flooring and upon the east base-board." The house was considerably shattered by the explosion, and finally burned down. The lady died in a few hours. A servant girl had just left the room, and escaped to narrate the cause of the disaster.

Great numbers of such disasters from liquid gasoline might easily be given. Its vapor has two objectionable qualities which tend to make it more dangerous than other inflammable gases. (1) It adheres readily to clothing, soaking into it like water, and (2) it is so much heavier than air that it flows through it and collects in pools almost as water would. Yet, on the other hand, it is used largely and continuously in many households, without accident. A high official of a great Western railway, universally known and respected, informs us that he has used a gasoline stove in his household for many years with entire immunity from accident; and that in view of the great additional safeguards thrown around the use of gasoline by the Frost carbureter plant, he feels quite warranted in using the latter for car lighting, which he does quite extensively. *

Passing from the record of experience, which, it must be admitted, is not yet sufficiently extensive to be decisive either way, we proceed to summarize the technical facts bearing on the question of probable permanent safety.

* That this is not a universal experience, however, is shown by a newspaper item which chances to strike our eye while revising proofs of this article, as follows: "Manning, Ia., March 21.—The explosion of a gasoline stove used to heat water in the baptismal font in a church here yesterday wrecked the font and set fire to the clothing of the minister, the Rev. Mr. Boles, burning him fatally."

## PERSONALS.

Gen. E. P. Alexander, President of the Central R. R. of Georgia, has resigned, and Mr. H. M. Comer, President of the Southbound R. R., has been elected to succeed him.

Mr. S. F. Prince has been appointed Superintendent of Motive Power of the Long Island R. R., vice Mr. C. A. Thompson, resigned.

Mr. William Kirkby, of Toledo, O., has been appointed Commissioner of Railroads and Telegraphs of Ohio, vice Mr. J. A. Norton, resigned, for the term ending March, 1893.

Col. Calvin Goddard, President of the Chicago & South Side Elevated Ry. Co., died in San Francisco, Cal., April 4, at the age of 55. He was at one time Treasurer of the New York & New England R. R., and was an expert accountant in railway affairs.

Mr. J. W. Miller, General Manager of the New York, Providence & Boston R. R., and President of the Providence & Stonington Steamship Co., has been elected Second Vice-President of the New York, New Haven & Hartford R. R. Co., which has secured control of these companies.

Mr. F. E. Mann has been appointed Superintendent of the Concord & Montreal R. R., with office at Concord, N. H.; Mr. Geo. E. Cummings is Assistant Superintendent of the Northern Division, with office at Woodsville, and Mr. W. G. Bean is Assistant Superintendent of the Southern Division, with office at Concord.

Mr. J. E. Greensmith has been appointed General Manager of the Portland Locomotive Works, Portland, Me.

Mr. E. B. Wetmore, Superintendent of the Suburban Rapid Transit R. R., New York, has been appointed Superintendent of the Chicago & South Side Elevated Ry.

The Cincinnati, Jackson & Mackinaw Ry. Co., Toledo, O., which has acquired the property of the Cincinnati, Jackson & Mackinaw R. R. Co., has the following officers: Gen. Man., F. B. Drake; W. D. Williams, Ch. Engr.; J. B. Flanders, Supt.; W. T. Backus, Supt. of the Ohio Division; A. H. Watts, Master Mechanic.

Mr. N. Harrell has been appointed Superintendent of Bridges and Buildings of the Yazoo Division of the Illinois Central R. R.

Mr. E. A. Mitchell, Mechanical Engineer of the New York, Lake Erie & Western R. R., has been appointed Superintendent of Motive Power, vice the late Mr. Ross Kells.

Mr. C. S. Mellen has been appointed General Manager of the New York & New England R. R., and Mr. I. D. Barton is General Superintendent.

Mr. A. V. Powell, C. E., has opened an office to carry on a general engineering practice at 151 Monroe St., Chicago, Ill., and will make a specialty of dock construction and equipment. Mr. Powell was formerly Commissioner of Public Works of Hyde Park, Ill., and for the past year has been in charge of the construction of docks at Ashtabula, O., for the Lake Shore & Michigan Southern Ry.

Mr. H. W. Clarke, M. Am. Soc. C. E., of Syracuse, N. Y., died Feb. 23. He was born at Harford, Pa., in 1837. In 1856 he became an assistant in the office of the City Surveyor of Syracuse, and was City Engineer from 1864 to 1869, with the exception of nine months, while in the army. From 1877 to 1886 he was engineer in charge of the re-survey of the boundary between New York and Pennsylvania, and in 1881 and 1882 was in charge of the survey of the line between New York and New Jersey. He was again appointed City Engineer in 1890, but was obliged to resign soon after, on account of ill health.

## NEW PUBLICATIONS.

APRIL MAGAZINES.—The "Popular Science Monthly" contains a paper on "Rapid Transit," by Carroll D. Wright, in which the census statistics on the cost of motive power on street railways (Eng. News), May 23, 1891), are discussed. Mr. Wright lays much stress on the importance of cheap and quick transit as an aid in solving many of the social problems, which the overcrowded cities present. In "Bacteria in Daily Products" Prof. W. H. Conn calls attention, among other things, to the process of Pasteurizing, in which milk is heated to a temperature of 155 deg. F. Any disease germs are killed and the milk will keep much longer before souring. Pasteurized milk is sold in French and German cities, the heating being done by machinery at very small cost. Its advantages are such that the process ought to be put in use in this country.

"Harper's" has an article on "Western Modes of City

Management" in which a good deal of praise and some criticism is awarded the municipal systems of Chicago, Minneapolis and St. Paul. A most admirable article on the same subject, we may note, is contained in this month's "Review of Reviews." It may surprise our readers to learn that in Minneapolis the City Engineer is a bigger man than the Mayor. The former's salary is $4,500, the latter's is $2,000. We notice a serious error in an article on Lake Superior and the territory surrounding it. The author, in describing the Michigan copper mines, says: "The region abounds with copper in the form of conglomerates, or mineral mixed with rock. The census report upon the district declares that 117,800,000 lbs. of this mineral yielded 87,445,000 lbs. of ingot, showing the percentage of copper to be 74.24." We need hardly say that, rich as are Calumet & Hecla and the mines surrounding them, the copper product of Michigan is not extracted from beds 75 per cent. pure. The author must have read Census Bulletin No. 96, very carelessly or he would have seen that the "mineral" which is there referred to is the concentrate produced by crushing and washing the ore. With the exception of the Calumet & Hecla and Tamarack mines, the average yield of the copper bearing rocks in Michigan was only 1 per cent. of ingot copper in the census year. The masses of native copper, which were the original source of Michigan's copper output, now cut no figure in her production and only a single mining company, and that an insignificant one, is still engaged in mining them.

Every one interested in the social and economic changes of the times should read the paper in "Scribner's" on "The Social Awakening in London." Americans have heard much of the gaunt poverty of East London, and of the numerous attempts at relief which have been and are being made; but gathering the knowledge here and there from a book, a newspaper, a brief reference in a magazine article, few have a really intelligent idea of just what is being done to relieve the misery and destitution of the swarming population in the greatest of modern cities. The paper is the first of a series on "The Poor in Great Cities," and if its quality is an index of those which are to follow, the series will equal in interest and value any of those which "Scribener's" has presented. Any of our readers who were interested in political matters in the days of impeachment trial of President Johnson should read the graphic story of that trial in this month's number by ex-Senator Edmund G. Ross, of Kansas, whose voice determined the result.

"The Nineteenth Century" this month opens with a paper on "New Stars," by Lockyer, the astronomer. His theory is that the appearance of new stars is due to the clash of metoric swarms moving at enormous velocity. The new star which appeared in February in the constellation Auriga in the Milky Way is believed to have been due to the collision of two meteoric swarms, which are now separating at a speed of at least 500 miles per second.

"The Century" also has an astronomical article by Prof. E. S. Holden, of the Lick Observatory, describing the total solar eclipses of 1889. The scanty opportunities which a generation affords for the observation of eclipses is not generally realized. Since the invention of the spectroscope in 1860 there has been barely a score of total eclipses, and a number of these could not be observed because the belt of totality fell in the polar regions or on the oceans. Thus less than three-quarters of an hour of actual observing time in total eclipses has been available to astronomers since the spectroscope and the photographic camera have been practically available. The leading paper this month is on "Our Common Roads," by Isaac B. Potter, and his description of the principles of Macadam and Telford road making, although quite elementary, as is necessary in a magazine article, will interest many engineers. A curious mistake of Mr. Potter is his statement that the wheels of an ordinary farm wagon are about 6 ft. apart longitudinally, and 4 1-2 ft. transversely. As a matter of fact, 8 ft. and 5 ft. are nearer the truth. We feel compelled to add further, much as we regret to even appear to throw cold water on a needed reform, that some of the opinions advanced in the first part of the article, as to the financial gain to the farmer to be had from better roads, are hardly defensible. We need better roads and ought to have them, but we shall not get them any sooner by exaggerating the loss from present conditions.

CONTOUR MAP OF THE UNITED STATES.—Compiled under the direction of Henry Gannett, Chief Topographer, by Harry King, Chief Draftsman, Department of the Interior, United States Geological Survey; J. W. Powell, Director. Nine sheets each 25 by 16 ins., and an index map.

This handsome map, which may be either mounted as a wall map or used in sheets, is made to a scale of 1-2,500,000, or approximately 40 miles to one inch. It is corrected up to April 1, 1891, and shows the contours in elevations of 100, 500, 1,000, 1,500 and 2,000 ft., and thereafter in 1,000 ft. planes above the sea-level. The map shows state and county boundaries, railways, etc., in black, and, all water courses in blue. The contours are in sepia.

DIE ELECTRISCHE SCHWEISSUNG UND LOETHUNG.—(Electric Welding and Soldering). By Etienne de Fodor, Director of the Electrical Central Station at Athens, Vienna, Pest, and Leipsig. A. Hartleben; 12mo., pp. 236; illustrations, 3 marks.

This handy text book, constituting volume XLIV. of Hartleben's series of electro-technical literature appears to contain about all the information which exists on its subject matter up to date. It is profusely illustrated. It describes all the recent methods and appliances used for the electric welding, soldering or smelting of different metals, so far as we have observed, and is written in a clear, comprehensive style. It gives precise tabular information, so far as the subject seems to admit of it, perhaps more fully than the present state of the art really justifies. We know of no book in English as yet published which treats of its special subject with such fullness and clearness.

GAS AND ELECTRIC LIGHT COMMISSIONERS OF MASSACHUSETTS. Report for 1891; 8vo., pp. 228; many tables.

Massachusetts, so far as we can learn, is the only state in the Union having a Board of Gas and Electric Light Commissioners. The reports of the Massachusetts Commission seem to more than justify its existence. They contain, we feel safe in saying, the most complete statistical information regarding a large number of gas and electric lighting plants to be found in any American publication.

From the report for 1891 can be gained a fair idea of the character and extent of the gas and electric lighting plants of Massachusetts, their financial condition, rates charged to municipalities and private consumers, output of gas, amount of gas unaccounted for, and other details of interest and value.

VALUE OF IRRIGATED LANDS AND PRICES OF WATER RIGHTS. By C. H. Tompkins, Jr. Idaho Mining and Irrigation Co. Pamphlet, pp. 22.

This pamphlet consists mostly of facts and figures showing the value of Western land before and after irrigation and the price charged for water rights in different parts of the West. The information is compiled from official reports, Engineering News, the "Irrigation Age," and other sources. A table of the value of the shares of a few irrigating companies states that the $250 shares of the Grand Canal Co., of Arizona, have a market value of $3,000. Another table gives the elevation above sea level of several irrigation centers, the highest level included being Del Norte, Colo., 7,890 ft., and the lowest Gila Bend, Ariz., 740 ft.

POCKET BOOK FOR USE OF ENGINEERS, ARCHITECTS AND BUILDERS. For 1892. Carnegie, Phipps & Co.; 12mo.

This useful book of shapes, tables, specifications, etc., for the users of steel and iron, among other changes and additions contains revised specifications for constructional iron and steel. Previous editions used what was called the "Manufacturers' Specifications," and these have recently been incorporated into many engineer's specifications. In the present edition, however, these are abandoned, and the well known and standard specifications of Mr. Theodore Cooper have been substituted for them, with some minor modifications.

## SOCIETY PROCEEDINGS.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—At the annual convention, which is to open at Saratoga, June 20, headquarters will be at Congress Hall. Application for rooms should be addressed to H. S. Clements, Saratoga Springs, N. Y.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—At the meeting on April 6, President Cohen in the chair, the Secretary announced that the annual convention will be held at the Hygeia Hotel, Old Point Comfort, Va., beginning June 8. He also announced the death of Mr. John Morton and the election as honorary member of Mr. James B. Francis, Past President of the society.

A paper on "The Main Relief Sewer of Brooklyn, N. Y.," was read by Mr. Willard Beahan, describing in detail this storm water relief sewer, which was described and illustrated in Engineering News, Jan. 6, 1892. The main part of this sewer, 9,340 ft. long, is in tunnel 10 to 15 ft. diameter, and was built on the pilot system of Anderson & Barr. The lower part, 2,940 ft. lonw, was built in open trench and discharges into a trap and silt basin with an outlet at the head of the Gowanus Canal.

In a written discussion, Major Sears expressed the opinion that the value of the paper would have been increased by some particulars of prices of material and work. Mr. Fteley said he thought the coefficient of .015 for the calculation of flow of water in brick tunnel, as used for calculating the desired capacity of tunnel, was too high, and he is using .014 for similar work. Mr. Hutton, referring to the use of shields in driving tunnels, wrote that at the St. Clair tunnel the air pressure was used mainly to balance the pressure of gas contained in the ground through which the tunnel was driven. Mr. Fteley described a Belgian shield for pneumatic work, which is patented in this country, and is to be used in Belgium. It has two partitions, the rear one having a part inclined backward and upward into the tunnel from near the bottom, forming a sort of hopper. In case of a rush or slide, the material would only rise a certain height between the partitions and in the hopper, being kept back by the air pressure, thus not filling the tunnel, and giving the men a chance to escape by steps up the side of the hopper. Mr. Bush described the first work of the Hudson River tunnel, where the Anderson pilot system was first used, as described in the Transactions May, 1880. Mr. Beahan, in replying to points brought up in discussion, said that in excavating 55 ft. below the surface, any loss of material from above would be shown by settlement of the street within 36 hours. Sand and boulders combined was the worst material for causing loss above the tunnel, as the flow of sand could not be checked. A majority of the tunnel men were Swedes, many of them sailors, as they were found to be of a mechanical turn of mind and were easily broken in to the work. Mr. Parker described a method of driving a shaft on a slope through a mass of loose rock.

The meeting of April 20 will be devoted to a discussion of the report of the committee on tests of iron and steel. The following candidates were declared elected: Members—E. H. Beckler, Ch. Engr., Pacific Ext., St. P., M. & M. Ry., Helena, Mont.; Edward Mohun, Ch. Engr., of Sewerage, Victoria, B. C.; Sam Tomlinson, Water-Works Department, Bombay, India. Associate Members—J. S. Elliott, West Indian Impt. Co., Jamaica, W. I.; W. C. Hawley, Chicago, Ill.; W. G. Kirkpatrick, of Landreth & Kirkpatrick, engineers, Nashville, Tenn.; Edwin Mitchell, Cumberland Valley R. R., Chambersburg, Pa.; W. F. Whittemore, Hoboken, N. J..

### COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF KANSAS CITY.
April 11. Baird Building. Secy., H. Goldmark.
WISCONSIN POLYTECHNIC SOCIETY.
April 11. Loan & Trust Bldg., Milwaukee. Secy., M. Shinke.
DENVER SOCIETY OF CIVIL ENGINEERS.
April 12. Secy., Geo. H. Angell, Jacobson Block.
ATLANTA SOCIETY OF CIVIL ENGINEERS.
April 12. Secy., Parker N. Black, Capitol Block.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
April 12. Secy., A. H. Porter, 50 Euclid Ave.
NORTHWESTERN SOCIETY OF ENGINEERS.
April 12. Occidental Block, Seattle. Secy., E. H. Warner.
ENGINEERING ASSOCIATION OF THE SOUTHWEST.
April 14. Secy., O. H. Landreth, Nashville, Tenn.
ENGINEERS' AND ARCHITECTS' CLUB OF LOUISVILLE.
April 14. Secy., Edward Mead, Norton Building.
MONTANA SOCIETY OF CIVIL ENGINEERS.
April 16. Secy., F. D. Jones, Helena.
ENGINEERS' CLUB OF PHILADELPHIA.
April 16, 1122 Girard St. Secy., J. C. Trautwine.
WESTERN RAILWAY CLUB.
April 19. Rookery Building, Chicago. Secy., W. H. Marshall.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
April 19. Secy., E. N. Clark, Pittsburg, Pa.
"Hydraulics of Large Rivers," Geo. S. Davison.
BOSTON SOCIETY OF CIVIL ENGINEERS.
April 20. Secy., S. E. Tinkham, City Hall.
ENGINEERS' CLUB OF ST. LOUIS.
April 20. Secy., Arthur Thacher, Odd Fellows' Building.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
April 20. Secy., F. Collingwood, 127 East 23d St., New York.
Discussion on tests of iron and steel.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
April 21. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERS' CLUB OF CINCINNATI.
April 21. Secy., J. F. Wilson.
SCANDINAVIAN ENGINEERING SOCIETY OF CHICAGO.
April 21. Secy., T. G. Philfeldt, 113 Adams St.
SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.
April 21. At Atlanta, Ga. Secy., F. A. Charpiot, Macon, Ga.
NEW YORK RAILROAD CLUB.
April 21. Secy., H. G. Prout, 73 Broadway.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
May 2. Secy., C. L. Annan.
WESTERN SOCIETY OF ENGINEERS.
May 4. Secy., J. W. Weston, 280 La Salle St., Chicago.
ENGINEERS' CLUB OF MINNEAPOLIS.
May 5. Public Library Bldg. Secy., F. W. Cappelen.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
May 6. Secy., E. K. Smoot, 806 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
May 6. Secy., O. von Geldern, 319 Market St., San Francisco.
SWEDISH ENGINEERS' CLUB.
May 7. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia.
NORTHWEST RAILROAD CLUB.
May 7. Union Station, St. Paul.
NEW ENGLAND RAILROAD CLUB.
May 11. United States Hotel, Boston. Secy., F. M. Curtis.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
May 13. Union Station, St. Paul.
TECHNICAL SOCIETY OF NEW YORK.
May 14. 194 Third Ave. Sec., H. Schrotter.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
May 14. At Roanoke. Secy., J. E. Schick, Roanoke, Va.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS.
May 16 to 20. San Francisco, Cal. Secy., F. R. Hutton, 12 W 31st St., New York.
AMERICAN WATER-WORKS ASSOCIATION.
May 16. Secy., J. H. Decker, East Orange, N. J.
CENTRAL RAILWAY CLUB OF BUFFALO.
May 25. Secy., Jas. Manbeth.
AMERICAN RAILWAY MASTER MECHANICS' ASSOC'N.
June 20. Saratoga, N. Y. Secy., A. Sinclair, New York.

# ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

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D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER, F. P. BURT, } ASSOCIATE EDITORS
GEO. H. FROST.....BUSINESS MANAGER

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*ADVERTISING RATES. 20 cents per line agate measure. Schedule sent on request. Changes of advertisements must be in hand on Tuesday afternoon: new advertisements, Wednesday afternoon; transient advertisements, not later than Thursday noon. The last pages go to press early on Friday, and we shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.*


We have been watching with some interest to see if the recent discussions of the present management of our national public works would result in the bringing forward of a tangible proposition for reform which would admit of definite discussion. Mr. George Y. Wisner, who started the discussion, essays to frame one in the first issue of the "Engineering Magazine," and in so doing well illustrates how much easier it is to find fault with things as they are than to reorganize them as they should be. With the substance of his aims in the abstract we have repeatedly expressed our entire sympathy, but it is amazing to us that any one who had given serious attention to the subject should believe that such a definite scheme as he outlines has the least chance of adoption, or that it would work even as well as the present management, if it were adopted. Mr. Wisner, indeed, declares the aim of his scheme to be to "secure to the public service the constant and effective influence of competition with the foremost engineers in private practice," which is precisely the right aim; and he follows this journal in the suggestion that where the nature of the work permits bidders may submit bids based either on the department plans or their own, or both, which is also well. But how does he propose to accomplish these results? To have Congress create a separate "Department of Engineering," the head of which, called "Chief Engineer" (and appointed for life), is to be also Secretary of the department, and a cabinet officer! Under him are to be four "Division Engineers," and under these again an unstated number of "Resident Engineers." All of these men are to be appointed as follows: The President is to appoint "five eminent civil engineers (no others need apply), "and preferably the presidents of principal engineering societies" (!) who are to nominate, and with the advice and consent of the President and Senate, appoint (for life) this cabinet officer and "Chief Engineer," the four Division Engineers, and even a "Chief of Finance"; all from among "the civil and military engineers of the present corps and such civil engineers as may be candidates!" The same board is to deal with the "required number of residents" in the same way; and apparently the lowest grade of "assistants" is to be the only one which is not appointed for life or good behavior.

The staff once filled up in this manner is to be maintained as follows: The "Chief Engineer" (no outsiders interfering) is "once a year or oftener, if necessary, to appoint a board of three eminent civil engineers, not in the service, and preferably the presidents of the most prominent engineering societies." This board is to nominate two candidates for each vacancy, and these nominations are to be submitted to ballot by the resident engineers, after the general style of the Am. Soc. C. E. ballots for admission to membership! Any civil engineer "qualified for the position" may be a candidate for any office, with the sole exception of the Chief Engineer (and cabinet officer). He may only be chosen from the "Division Engineers," but he also is to be chosen in the same way as every one else, by ballot of the residents!

To make this precious scheme complete it ought to have been further provided that the President, as the ultimate chief of this chief engineer, should hereafter bear the title of Grand Chief Engineer and be elected by ballot of the Division Engineers. It is discouraging to see such nonsense put forth by engineers in engineering journals as embodying claims or hopes of civil engineers. That such a "department," thus managed and recruited, would soon become a perfect sink of jobbery and inefficiency: that it violates every principle of sound business judgment in permitting the underlings to choose their chief, as militiamen choose their officers, is too plain for discussion. Fancy the effect of allowing the underlings of the Treasury or Navy Departments, for example, to elect their chiefs! The civil assistant engineers in the United States service may well cry, Save me from my friends: and Congress may well conclude that there is really no solid basis in the complaints made against the present status when it sees such schemes proposed as alternates. And yet there are real and just grounds for complaint, which, when reasonably presented, will doubtless be reasonably weighed.

The tremendous concentration of values in modern cities is strikingly illustrated by a fact which we observe in some recent statistics before us. Not less than one-third of the land and rental values of England and Wales, and over one-fourth of the total of these values for England, Wales, Scotland and Ireland, are concentrated in London. In round numbers, the land and rental values of London (precisely what is meant by or included in that term we do not know), are $175,000,000; for the entire United Kingdom they are only $698,000,000, or a little less than four times as much.

The same striking concentration of values is shown in the valuations of New York. The city valuations are generally taken to be on the basis of between 50 per cent. and 60 per cent. of true market value, and the country valuations somewhat less; but the State Board of Equalization is supposed to reduce the two assessments to the same ratio with market value, and the assessed valuations for 1890 stand about as follows in round numbers:

| | | |
|---|---|---|
| New York (city)..... | $1,243,000,000 | |
| Brooklyn..... | 401,000,000 | $1,644,000,000 |
| All the rest of New York (state)..... | | 2,131,000,000 |
| Total assessed valuation of state..... | | $3,775,000,000 |
| Total assessed valuation of United States $24,250,000,000 which is about 40 per cent. only of true valuation, and hence should be increased at least one-third to compare with New York state valuation; or, to..... | | $36,375,000,000 |

It will be seen that the valuation of "Greater New York," if we should include Staten Island and Jersey City, is nearly as great as that of all the rest of the state put together, including Buffalo, Rochester and quite a list of other good-sized cities. What is really still more surprising, New York and Brooklyn alone account for 1-22d part of the entire valuation of the United States, though Chicago, Philadelphia and Boston are each larger than New York was a few years ago. In future, in this country, as in England, a large and increasing proportion of the heavy engineering work will be done in cities.

## THE EFFICIENCY OF WORM GEARING.

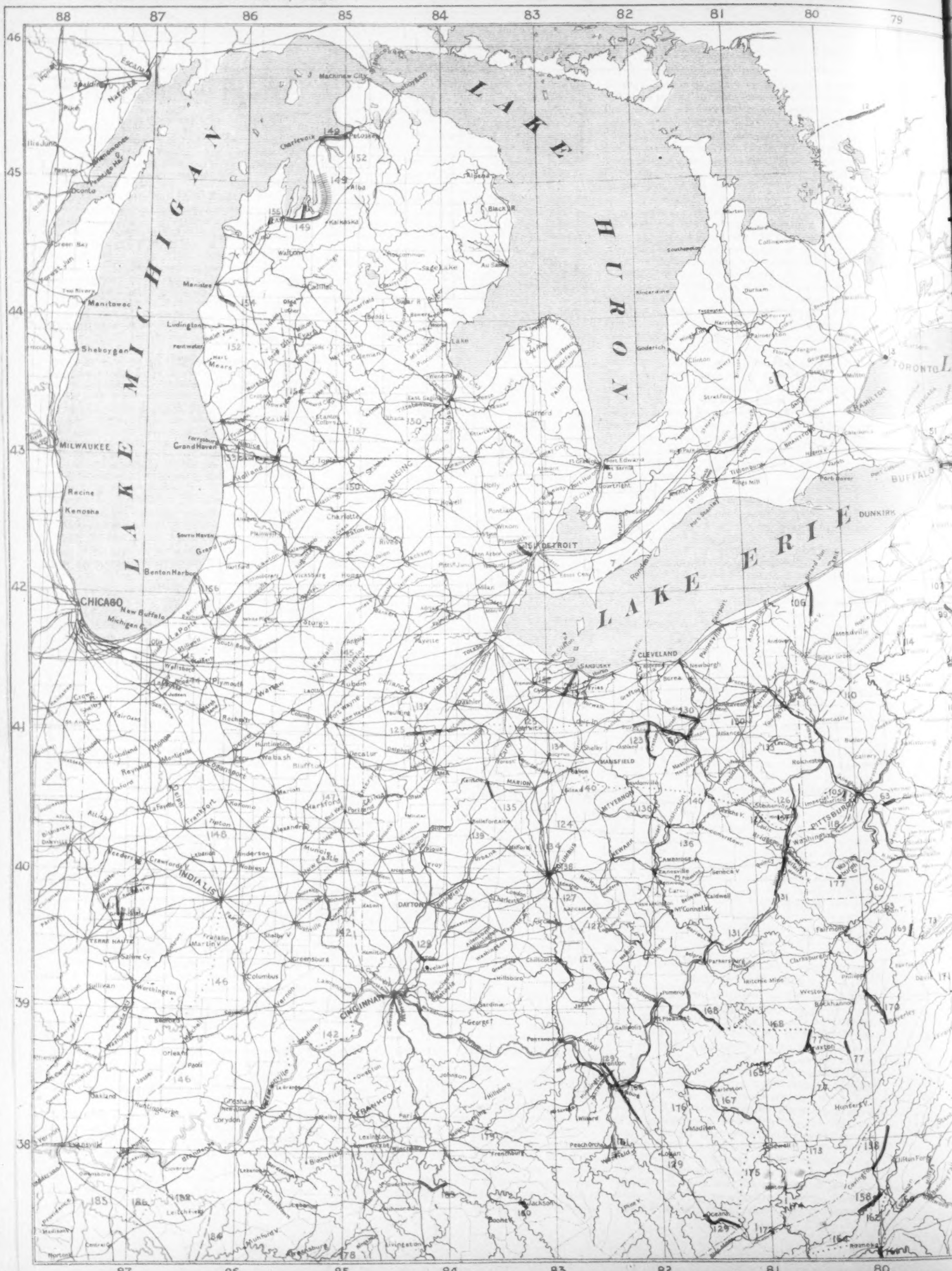
The experiments on the efficiency of worm gearing described in another column may serve to call attention to the frequent errors which are made in the design of this class of gearing, which is admirably adapted for some uses, but is certain to give trouble if required to work at speeds or loads beyond its capacity. Because the worm gear is such a compact mechanism for gaining power at the expense of velocity, the temptation is great to use it wherever it is desired to take power from a fast running shaft, for driving mechanism at a considerably lower speed. Various experiments have shown, however, that even with very light loads a worm will begin to heat and cut if run at too high a speed, the limit for safe working being a velocity of the rubbing surfaces of 200 to 300 ft. per minute, the former quantity being preferable where the gearing has to work continuously. It is easy to see why worm gearing is unsuited to high speeds. The worm in its work of driving the wheel absorbs some 10 to 50 per cent. of the power in overcoming friction, and this proportion of the total power applied to the worm shaft is thus converted into heat. Part of this heat goes to the worm-wheel teeth and part to the worm. The wheel teeth will keep cool, as they form part of a casting having a large radiating surface: but the worm itself is so small that its heat is dissipated slowly. Whenever the heat generated increases faster than it can be conducted and radiated away, the cutting of the worm may be expected to begin very soon. It is apparent from this that a low efficiency for a worm gear means more than the loss of a certain amount of power, since the power which is lost reappears as heat and may cause the rapid destruction of the worm. The greater the efficiency of a worm gear, therefore, the greater the speed at which it can be safely run to transmit a given amount of power.

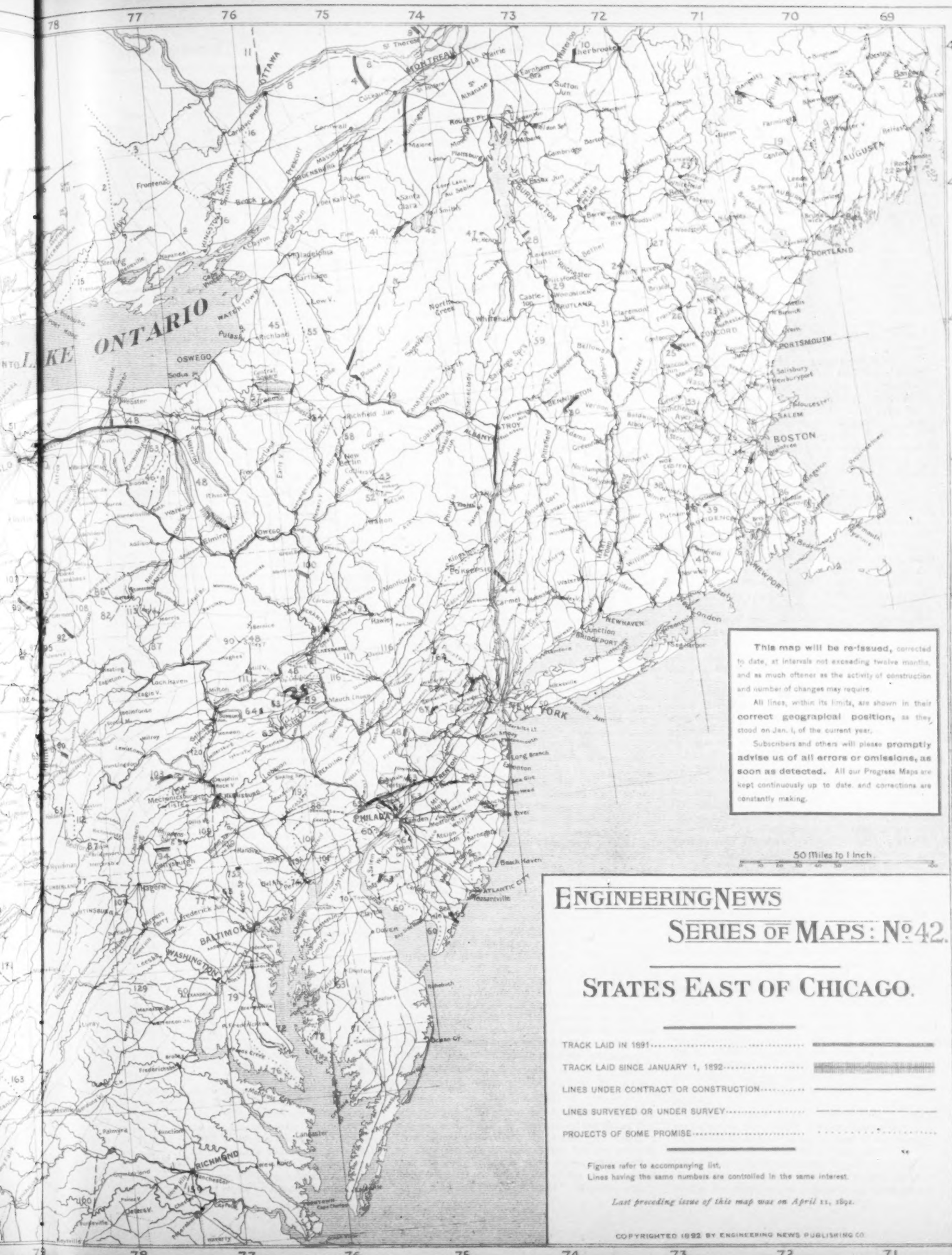
Another error sometimes made in designing worm gearing is the adoption of a small pitch or obliquity, the endeavor being to obtain the highest possible reduction of speed without increasing the size of the worm-wheel. The experiments elsewhere described show the marked loss of efficiency which this causes; and for places where the amount of power transmitted is considerable, or where the source of the power is limited, as in the case of mechanism worked by manual power, the worm should always have a steep pitch.

The efficiencies of 40 per cent. to 55 per cent., which were found in the experiments, are somewhat lower than those usually obtained in experiments on worm gearing. This is principally due to the fact that in these experiments the friction of four shaft bearings and two thrust bearings is included with the friction of the worm, and the efficiency given in the diagram is that of the whole mechanism and not that of the worm alone. But inasmuch as thrust and shaft bearings are generally used in connection with worm gearing, the efficiency of the whole mechanism is often more convenient for use in practical work than the efficiency of the worm alone. It should not be forgotten, however, that the friction of the thrust bearings especially, is very considerable, and where much power is transmitted they are apt to give trouble by heating and cutting. Wherever possible some means should be provided for avoiding loss and trouble from this cause. Some success has been attained in this direction by the use of anti-friction bearings: and in an electric pumping plant, described in our issue of March 12, thrust bearing friction was wholly obviated in one case by using two worms of opposite inclination on one shaft, and in another by placing the worm on a vertical shaft which weighed with its attachments enough to counteract the upward thrust of the worm. Those who desire to study this subject further will find an admirable paper by Mr. Wilfred Lewis and discussion by Mr. Henry R. Towne in the American Society of Mechanical Engineers' Transactions, Vol. VII., p. 273.

## RAILWAY CONSTRUCTION IN THE STATES EAST OF CHICAGO.

We publish with this issue the fifth annual number of our map and statistics showing the new railway construction of the states east of Chicago. According to the figures given 92 miles of railway (including 2 miles in Kentucky) have been completed since Jan. 1, 1892, in the 17 states and that portion of the Dominion of Canada included on the map, and there are now 1,783 miles in process of construction, 3,907 surveyed or under survey, and 2,197 miles projected with a fair prospect of being put under contract within the next two years, making a total of 7,979 miles of railway, including all classes of work, under way. The following table gives the mileage of railway in the various stages of progress in each of the states included wholly on the map, with the exception of West Virginia, which more properly belongs to the Southern states in general characteristics and development:


LAKE MICHIGAN
LAKE HURON
LAKE ERIE
CHICAGO
MILWAUKEE
DETROIT
CLEVELAND
TOLEDO
SANDUSKY
MANSFIELD
MARION
COLUMBUS
DAYTON
CINCINNATI
INDIANAPOLIS
TERRE HAUTE
PITTSBURGH
WHEELING
ZANESVILLE
NEWARK
LANCASTER
CHILLICOTHE
PORTSMOUTH
ASHLAND
Mackinaw City
Cheboygan
Charlevoix
Petoskey
Alba
Traverse City
Manistee
Manistique
Escanaba
Menominee
Marinette
Green Bay
Manitowoc
Two Rivers
Sheboygan
Ludington
Muskegon
Grand Haven
Holland
Benton Harbor
South Haven
Kenosha
Racine
Waukegan
Michigan City
New Buffalo
LaPorte
Sturgis
Plymouth
Warsaw
Rochester
Huntington
Wabash
Logansport
Peru
Kokomo
Marion
Muncie
Anderson
Noblesville
Indianapolis
Crawfordsville
Lafayette
Frankfort
Attica
Danville
Terre Haute
Greencastle
Greensburg
Columbus
Seymour
Madison
Vincennes
Washington
Orleans
Paoli
Jasper
Huntingburg
Evansville
Princeton
Oakland
Crayden
Hopkinsville
Clarksville
Nashville
Bowling Green
Louisville
Shelbyville
Frankfort
Lexington
Georgetown
Cynthiana
Paris
Maysville
Ripley
Ironton
Portsmouth
Gallipolis
Pomeroy
Middleport
Point Pleasant
Huntington
Ashland
Catlettsburg
Ceredo
Kenova
Ashland
Grayson
Olive Hill
Ashland
Flatwoods
Greenup
Wheelersburg
Portsmouth
Sciotoville
Jackson
Wellston
Ironton
Ashland
Mansfield
Shelby
Bucyrus
Galion
Marion
Delaware
Columbus
Springfield
Xenia
Dayton
Hamilton
Middletown
Cincinnati
Lawrenceburg
Aurora
Rising Sun
Vevay
Madison
Jeffersonville
New Albany
Corydon
Salem
Seymour
Columbus
Shelbyville
Greensburg
Rushville
Connersville
Richmond
Hagerstown
Winchester
Muncie
Marion
Peru
Logansport
Rochester
Plymouth
Knox
Walkerton
Hart
Mears
Whitehall
Muskegon
Grand Rapids
Allegan
Kalamazoo
Battle Creek
Jackson
Ann Arbor
Ypsilanti
Detroit
Wyandotte
Trenton
Monroe
Toledo
Fremont
Sandusky
Norwalk
Tiffin
Fostoria
Findlay
Bucyrus
Mansfield
Ashland
Wooster
Orrville
Akron
Cleveland
Painesville
Ashtabula
Conneaut
Erie
Dunkirk
Buffalo
Niagara Falls
Tonawanda
Lockport
Rochester
Batavia
Attica
Olean
Salamanca
Jamestown
Meadville
Titusville
Oil City
Franklin
Pittsburgh
Washington
Wheeling
Steubenville
Cadiz
Cambridge
Zanesville
Newark
Lancaster
Logan
Athens
Pomeroy
Middleport
Point Pleasant
Parkersburg
Marietta
Belpre
Ravenswood
Ripley
Maysville
Augusta
Carlisle
Lebanon
Middletown
Hamilton
Cincinnati
Covington
Newport
Bellevue
Dayton
Springfield
Urbana
Piqua
Troy
Sidney
Lima
Findlay
Fostoria
Tiffin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LAKE ONTARIO
OSWEGO
MONTREAL
OTTAWA
ALBANY
TROY
BOSTON
PORTLAND
AUGUSTA
CONCORD
PORTSMOUTH
SALEM
PROVIDENCE
NEWPORT
NEW HAVEN
NEW YORK
PHILADA
BALTIMORE
WASHINGTON
RICHMOND
ATLANTIC CITY
BURLINGTON
RUTLAND
This map will be re-issued, corrected to date, at intervals not exceeding twelve months, and as much oftener as the activity of construction and number of changes may require.
All lines, within its limits, are shown in their correct geograpical position, as they stood on Jan. 1, of the current year.
Subscribers and others will please promptly advise us of all errors or omissions, as soon as detected. All our Progress Maps are kept continuously up to date, and corrections are constantly making.
50 Miles to 1 Inch.
ENGINEERING NEWS
SERIES OF MAPS: No. 42.
STATES EAST OF CHICAGO.
TRACK LAID IN 1891
TRACK LAID SINCE JANUARY 1, 1892
LINES UNDER CONTRACT OR CONSTRUCTION
LINES SURVEYED OR UNDER SURVEY
PROJECTS OF SOME PROMISE
Figures refer to accompanying list.
Lines having the same numbers are controlled in the same interest.
Last preceding issue of this map was on April 11, 1891.
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| States. | Track laid In year 1891. | Track laid To date in 1892. | In process of con- str'ct n. | Surv'y'd or under survey. | Projects of some prom- ise. |
|---|---|---|---|---|---|
| Maine | 5. | ... | 20 | 441 | 48 |
| New Hampshire | 9.65 | ... | 22 | 73 | ... |
| Vermont | 20.26 | ... | ... | 32 | 25 |
| Massachusetts | 7.76 | 2 | 20 | 53 | 8 |
| Rhode Island | 4. | ... | ... | 17 | ... |
| Connecticut | ... | ... | ... | 18 | ... |
| New York | 173. | 39 | 165 | 227 | 215 |
| New Jersey | 40.34 | ... | 25 | 76 | 115 |
| Delaware | ... | ... | 5 | ... | 25 |
| Maryland | 3. | 2 | 90 | 231 | 125 |
| Pennsylvania | 299.55 | 20 | 293 | 707 | 237 |
| Ohio | 48.35 | 8 | 262 | 345 | 270 |
| Indiana | 29.42 | ... | 173 | 259 | 230 |
| Michigan | 88.37 | 19 | 169 | 259 | 80 |
| Total | 737.7 | 90 | 1,154 | 2,708 | 1,378 |

The table shows that Pennsylvania heads the list in the amount of work, it having 1,227 miles of new railway under way. Ohio follows with 885 miles, and then come Indiana, New York, Michigan and Maine, in the order named, with 662 miles, 644 miles, 527 miles, and 509 miles, respectively. Comparing the totals given in the table with those published with the last preceding map of this section, we have the following results at the dates named:

| Date. | Track laid Year previous. | Track laid Portion of year to date. | Under con- struc- tion. | Under survey. | Pro- jected. |
|---|---|---|---|---|---|
| April 11, 1891 | 935 | 78 | 1,006 | 2,845 | 2,781 |
| April 9, 1892 | 738 | 90 | 1,154 | 2,708 | 1,378 |
| Inc. or dec. 1892 | —197 | -|-12 | -|-88 | —47 | —1,403 |
| " p. c. | —21.06 | —15.38 | -|-8.15 | -|-1.65 | —50.4 |

It will be seen that the mileage of new railway under construction and completed this year is somewhat greater than it was a year ago, and that the mileage now under survey, or upon which surveys have been completed, is only 47 miles, or 1.65 per cent. less now than in 1891. The mileage of projected lines, which from present indications have some prospect of being put under survey and construction within the next twelve or eighteen months, however, shows a decrease of 50.4 per cent. from last year's figures. This is owing partly to the decrease in the inception and organization of new projects attendant upon the industrial disturbances and the small railway construction of the past year, and partly to the fact that several somewhat ambitious enterprises, which seemed to have sufficient vitality a year ago to be worthy of inclusion on our map, have made no advance since, and are not included in our present figures. Work is in actual progress upon a very large proportion of the 1,154 miles under construction, as will be seen from our detailed list, and the present prospects indicate that quite a large percentage of this mileage will be carried to completion this year. It will also be noticed that several of the lines upon which work is in progress are of considerable length. These are in general being built by, or in the interest of, some of the larger systems, and have plenty of capital back of them. A large proportion of the work, however, is being done on short branches and extensions to develop local traffic. This is especially noticeable in Pennsylvania, which, as before stated, has the largest mileage of new railway under way. The greater number of the lines in this state are under 25 miles in length.

The mileage of railway under way in Ontario and the eastern provinces of Canada, and the three Southern states wholly or partly shown on the map, is shown in the following table:

| | Track laid 1891. | Track laid To date in 1892. | In process of con- struc- tion. | Surveyed or under survey. | Projects of some prom ise. |
|---|---|---|---|---|---|
| Canada | 151 | .. | 162 | 281 | 458 |
| Virginia | 102 | .. | 80 | 389 | 185 |
| West Virginia | 177 | .. | 242 | 273 | 152 |
| Kentucky | 43 | 2 | 145 | 166 | 24 |
| Total | 533 | 2 | 629 | 1,109 | 819 |
| April 11, 1891 | | 101 | 663 | 1,981 | 1,991 |
| Decrease, 1892 | | 99 | 34 | 872 | 1,172 |
| Dec., per cent | | 98 | 5.11 | 44 | 58.8 |

Considering the work somewhat in detail it will be seen that very little active construction is being carried on in the New England states. The state of Maine has the largest mileage under survey, including several lines of considerable length. The most important of these are the Bangor & Aroostook R. R., and the Maine Shore Line R. R. The former will be 230 miles long, including branches, and will penetrate the timber region of Aroostook county and connect the railway system of southern Maine with the Canadian Pacific Ry. and the eastern provinces of Canada. This line has been located and the promoters inform us that work will begin this spring, and a considerable portion of the line be completed this year. The Maine Shore Line R. R. is projected to run along the Atlantic coast in Hancock and Washington counties, and will be 112 miles long. Both of these lines have secured a large amount of local aid, and the prospects for their construction seem fairly good. The other work in New England consists mostly of short branches and extensions.

The most important lines under way in New York are the double-track extension of the Lehigh Valley Ry. to Buffalo, N. Y., and the new Adirondack & St. Lawrence R. R. through the Adirondack lake region. A single track of the Lehigh Valley company's extension was completed from Geneva to Buffalo, 101 miles, last year, and work is now in progress upon the second track, and also upon the remainder of the line from Geneva to Van Ettenville. The Adirondack & St. Lawrence R. R. is being built in the Vanderbilt interest, and will connect the New York Central & Hudson River R. R. with the Canadian Pacific Ry., and give htat company an independent line to Montreal, P. Q., through the heart of the Adirondack lake region. About 90 miles of the line have been completed, and work is being actively pushed on the remainder. The other work in New York, as well as the work in Pennsylvania, consists largely of short lines, and is sufficiently described in our detailed list.

The proposed extension of the West Virginia Central & Pittsburg R. R. to Baltimore, is the most important line under way in Maryland. The surveys for this line have been made and the projectors state that work will probably be commenced at an early date. It is doubtful, however, if any work is done this year. In West Virginia work is making good progress on the Ohio extension of the Norfolk & Western R. R., and several shorter lines are well under way.

In Ohio the extension of the Baltimore & Ohio R. R. from Akron to Chicago junction has been completed, giving that company, in connection with the Pittsburg & Western R. R., a new line to Chicago. Of the other lines, the Sandusky & Columbus Short Line is being rapidly built from Columbus, O., to a lake harbor at Sandusky, O.; the Toledo, Walhonding Valley & Ohio R. R. is being graded between Londonville and Coshocton, 46 miles; and work is in progress on the extension of the Findlay, Fort Wayne & Western R. R. to Fort Wayne, Ind. Each of these roads will probably complete a considerable portion of its track this season.

The only line of any length in Indiana is the proposed extension of the Wabash R. R. from Montpelier, O., to Hammond, Ind., 165 miles. This line is projected to give the Wabash Co., which now uses the tracks of the Chicago & Erie R. R., an independent line into Chicago. The surveys have been completed and grading is in progress.

Less work is under way in Michigan than for some years heretofore. The Chicago & West Michigan R. R. Co. is the only company having any amount of active work in progress in the portion of the state shown. Its line along the northeastern shore of Lake Michigan is being rapidly built, and will probably be in operation some months before the close of the year. The several enterprises in the Northern Peninsula of Michigan, as well as the work in Virginia and Kentucky, will be shown and discussed in connection with our map showing the progress of railway construction in those sections.

Taking the section of country covered by the map as a whole, it may be said that the outlook for new railway construction this year is fully as good as usual. It seems probable from present indications that quite as much track will be laid in these states during 1892 as there was in the year just passed.

## THE NEED FOR UNIFORMITY IN RAILWAY LAWS.

In a recent magazine article Prof. Henry C. Adams, statistician of the Interstate Commerce Commission, well says: "It is not more schemes or plans for the solution of the railway problem that are desired, but a more careful study and a more conscientious application of the plan to which the country has committed itself." How thoroughly the country has committed itself to the policy of commissions, created and empowered by legislative acts, as a means of regulating the dealings of the railways with each other and with the public, is graphically shown by the map and table on another page; and whatever is done to improve the relations between the public and the railways, or between the various railway corporations, must be done mainly through these commissions. In their present condition, however, they are in several respects inefficient and incapable of obtaining the objects for which they were devised. On the whole, there has been a decided advance from the conditions of the past, but long and frequent rate wars, frequent evasions and violations of the laws and the antagonistic feeling of the people toward the railway companies in many states, show that there is yet much to gain.

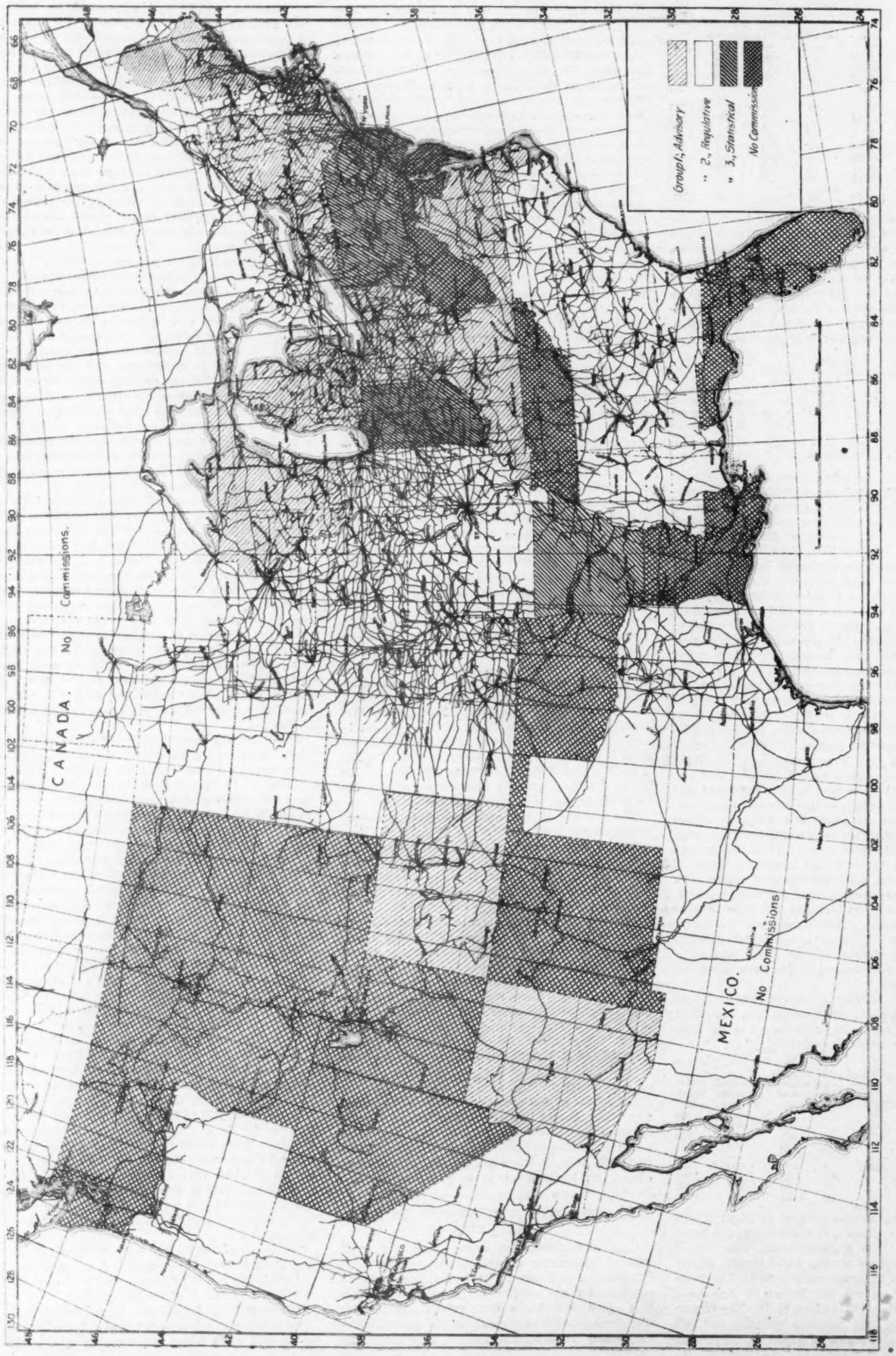
This relative inefficiency is due, we take it, to three facts: (1) The construction of the commissions and the form of the laws creating them; (2) the lack of machinery and power to enforce the laws, and (3) the lack of harmony and uniformity in the statutes which the several states and the United States have passed. In this last condition lies a very great and injurious element of inefficiency, and any improvement in it, carried out on lines which experience proves to be best, will surely effect a corresponding improvement in the two other conditions. That harmony and uniformity are necessary in the laws regulating railway operations is generally conceded, and within the last few years considerable progress has been made in this direction. Much more, however, remains to be done.

In a monograph entitled, "State Railroad Commissions, and How They May Be Made Effective," recently published by the American Economic Association, Mr. Frederick C. Clark has collected in a (generally) convenient form a large amount of information in regard to the organization and statutory powers of the various state railroad commissions. We have abstracted and rearranged the more important of these data in the accompanying table, which appears on a following page, using the author's classification and grouping. In this table it has been possible to give only the general provisions of the various statutes, neglecting minor details, and it should be studied with this understanding, but the table appears to us to be full of instruction.

It will be seen that 34 of the 49 states and territories, including all the more important ones, have some form of a commission for regulating railway operations. In four of these, however, the commissions are composed of state officers whose duties are: To collect statistics, in Pennsylvania; to assess railway property for taxation, in Indiana and New Jersey, and to perform both of these duties, in Arkansas; and who have very few other duties. The remaining 30 states have regularly organized commissions. The 34 states having commissions are divided into three groups according to certain characteristic functions. The first group (shown lightly hatched on the following map) comprises 13 states in which the duties and powers of the commissions are mainly advisory and supervisory; the second group comprising 17 states, and shown unhatched or white on the following map, contains those commissions having, in addition to these advisory and supervisory powers, regulative powers. The third group comprises the states of Arkansas, Pennsylvania, New Jersey and Indiana, before mentioned, and is shown darkly hatched. The fourth group, which has nothing in the nature of a railway commission, is shown double-hatched, not to indicate the moral obliquity of their (lack of) action, but for the more prosaic reason that otherwise the black areas would have been too extensive and would have obscured the railway lines of the country, all of which appear in the map in their correct geographical position, small as the scale is. Canada and Mexico, although neither of them has anything in the nature of a railway commission, are left unhatched.

The map referred to was redrawn from a similar map given in Mr. Clark's monograph, and extended to include the entire railway system of the country, as it stood on Jan. 1 of the current year.

The great lack of uniformity in the provisions devised to regulate the same detail of railway business is the first thing which impresses us upon exami-




MAP OF THE UNITED STATES INDICATING BY HATCHINGS THE RELATIVE POWERS POSSESSED IN THE SEVERAL STATES BY THE RAILWAY COMMISSIONS.

Group 2, which is left unshaded, includes those states in which the commissions have fullest powers, regulative, advisory and statistical. Group 1, which is lightly hatched, includes those states in which the commissions have advisory and statistical, but no regulative powers. Group 3, which is heavily hatched, includes those states in which the commissions have statistical and assessing, but no advisory or regulative powers. Those states having no railway commissions whatever are shown cross-hatched.

TABLE SHOWING THE SEVERAL POWERS OF THE STATE RAILROAD COMMISSIONS, AND THEIR LACK OF UNIFORMITY UNDER THE LAW.

| | ORGANIZATION. | | | POWERS. | | | | | | | | DUTIES. | | | | | LAWS. | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No. of comrs. | Term of office. | Fiscal year ends June 30. | To classify frt. and pass. traffic. | To fix, revise, alter or make rates. | To enforce decisions or orders. | To examine accounts, &c. | To require uniform acc'ts. | To institute proceedings. | To regulate connections and terms of interchange | To report annually. | To use forms of 1891, inter. Com. Com. | Req'd to examine and rep't accidents. | Req. to inspect roadbeds. | Req. to ex. financial management. | To recommend legislation. | Frt. rates limited by law. | Pass. rates limited by law. | No. days notice required. reduction. | No. days notice required. advance. | Rates req'd to be posted. | Pooling prohibited | Consol. of comp. lines prohibited | Discrimination prohibited | Fictitious inc. stock prohibited | By. const'n limited by law. | |
| U.S. Interstate C. | 5 | 6 | yes | yes | yes | yes | NO | yes | NO | yes | yes | yes | NO | NO | NO | NO | NO | NO | 10 | 3 | yes | yes | NO | yes | NO | NO | Interstate |
| GROUP 1. COMMISSIONS HAVING ADVISING AND SUPERVISING POWERS ONLY. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mass. | 3 | 3 | yes | NO | NO | NO | yes | NO | NO | yes | yes | NO | yes | yes | yes | yes | NO | NO | None | None | NO | NO | NO | yes | yes | Mass. |
| Conn. | 3 | 4 | yes | NO | NO | NO | NO | NO | NO | yes | yes | yes | yes | yes | NO | yes | NO | NO | " | " | NO | NO | NO | yes | NO | Conn. |
| Vt. | 3 | 4 | yes | NO | NO | NO | yes | NO | NO | NO | Biennially | yes | yes | yes | yes | NO | NO | NO | " | " | NO | NO | NO | yes | yes | Vt. |
| Me. | 3 | 3 | yes | NO | yes | NO | NO | NO | yes | yes | yes | yes | yes | yes | yes | yes | NO | NO | " | " | NO | NO | NO | yes | NO | Me. |
| N. Y. | 3 | 5 | yes | NO | NO | NO | yes | NO | NO | NO | yes | yes | yes | yes | yes | yes | NO | yes | " | " | NO | NO | NO | yes | NO | N. Y. |
| Ohio | 3 | 5 | yes | NO | NO | NO | NO | NO | NO | NO | yes | NO | yes | yes | NO | NO | NO | NO | " | " | NO | NO | NO | yes | NO | Ohio. |
| R. I. | 1 | 1 | yes | NO | NO | NO | yes | NO | NO | NO | yes | NO | yes | NO | NO | NO | yes | NO | " | " | NO | NO | NO | yes | NO | R. I. |
| Mich. | 1 | 6 | No | NO | NO | NO | yes | NO | yes | yes | yes | NO | yes | yes | NO | NO | yes | yes | " | " | NO | NO | NO | yes | NO | Mich. |
| Wis. | 1 | 6 | yes | NO | NO | NO | yes | NO | NO | NO | Biennially | NO | NO | NO | NO | NO | yes | yes | " | " | yes | NO | NO | NO | NO | Wis. |
| Va. | 1 | 4 | yes | NO | NO | NO | NO | NO | NO | NO | yes | yes | yes | yes | NO | NO | yes | yes | " | " | yes | NO | NO | NO | NO | Va. |
| Ky. | 3 | 4 | yes | yes | yes | yes | yes | yes | yes | yes | yes | NO | yes | yes | NO | NO | NO | NO | 10 | 10 | yes | yes | yes | yes | NO | Ky. |
| Ariz. | 3 | 4 | yes | yes | yes | NO | NO | NO | NO | NO | yes | yes | NO | yes | NO | yes | yes | yes | None | None | NO | NO | NO | yes | NO | Ariz. |
| Colo. | 3 | 4 | yes | NO | NO | yes | NO | NO | yes | NO | yes | yes | yes | NO | NO | yes | NO | NO | " | " | yes | NO | NO | yes | NO | Colo. |
| GROUP 2. COMMISSIONS HAVING BOTH ADVISORY AND REGULATIVE POWERS. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ill. | 3 | 3 | yes | yes | yes | yes | yes | NO | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | None | None | NO | NO | NO | yes | NO | Ill. |
| Ia. | 3 | 3 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NO | yes | 10 | 10 | yes | yes | NO | NO | NO | Ia. |
| Minn. | 3 | 3 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NO | yes | NO | yes | yes | yes | 10 | 10 | yes | yes | NO | NO | NO | Minn. |
| Kan. | 3 | 3 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | 60 | None | yes | yes | yes | yes | NO | Kan. |
| Mo. | 3 | 6 | N.) | yes | NO | yes | NO | NO | yes | NO | yes | NO | NO | NO | NO | NO | yes | yes | 10 | " | NO | yes | yes | yes | NO | Mo. |
| Cal. | 3 | 4 | NO | yes | yes | yes | yes | yes | yes | yes | yes | NO | yes | yes | NO | yes | yes | NO | None | " | yes | yes | yes | yes | NO | Cal. |
| Ala. | 3 | 4 | yes | yes | yes | yes | yes | NO | yes | yes | yes | yes | yes | yes | NO | yes | yes | yes | " | " | yes | yes | NO | yes | NO | Ala. |
| Ga. | 3 | 6 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NO | yes | yes | yes | " | " | yes | yes | NO | yes | NO | Ga. |
| S. C. | 3 | 6 | yes | yes | yes | yes | yes | NO | yes | yes | yes | yes | yes | yes | NO | NO | yes | yes | 1 | 1 | yes | yes | NO | yes | NO | S. C. |
| Miss. | 3 | 4 | yes | yes | yes | yes | yes | NO | yes | yes | Biennially | yes | yes | yes | NO | NO | NO | NO | 30 | 30 | yes | yes | NO | yes | NO | Miss. |
| N. H. | 3 | 3 | yes | yes | yes | yes | yes | yes | yes | NO | yes | NO | yes | yes | NO | NO | NO | NO | None | None | yes | yes | yes | yes | yes | N. H. |
| N. Dak. | 3 | 3 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NO | yes | NO | NO | 10 | 10 | yes | yes | yes | yes | yes | N. Dak. |
| S. Dak. | 3 | 3 | yes | NO | yes | yes | yes | NO | yes | yes | Biennially | yes | NO | yes | NO | yes | NO | NO | 10 | 10 | yes | yes | NO | yes | NO | S. Dak. |
| Ore. | 3 | 4 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NO | NO | NO | yes | NO | NO | 6 mos. | None | yes | yes | NO | yes | NO | Ore. |
| Texas | 3 | 6 | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | NO | NO | NO | NO | yes | yes | 10 | 10 | yes | yes | yes | yes | NO | Tex. |
| Neb. | 3 | 3 | yes | yes | yes | NO | NO | NO | yes | yes | yes | yes | NO | NO | NO | yes | yes | yes | None | None | yes | yes | yes | yes | NO | Neb. |
| N. C. | 3 | 6 | yes | NO | NO | yes | NO | NO | yes | NO | yes | NO | NO | NO | NO | yes | NO | NO | " | " | NO | NO | NO | yes | NO | N. C. |
| GROUP 3. COMMISSIONS HAVING STATISTICAL AND ASSESSING POWERS ONLY. | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ark. | 3 | 2 | yes | NO | NO | NO | NO | NO | NO | NO | yes | NO | NO | NO | NO | NO | yes | yes | None | None | yes | yes | yes | yes | NO | Ark. |
| Pa. | 3 | 4 | yes | NO | NO | NO | NO | NO | NO | NO | yes | NO | NO | NO | NO | NO | NO | NO | " | " | NO | NO | NO | NO | NO | Pa. |
| N. J. | 3 | 4 | NO | NO | NO | NO | NO | NO | NO | NO | yes | NO | NO | NO | NO | NO | NO | NO | " | " | NO | NO | NO | NO | NO | N. J. |
| Ind. | 3 | 5 | NO | NO | NO | NO | NO | NO | NO | NO | yes | NO | NO | NO | NO | NO | NO | NO | " | " | NO | NO | NO | NO | NO | Ind. |

nation of the table. Not only does this confusion exist in the laws covering different and distantly separated sections of the country, where difference in the state of trade and character of traffic might partly warrant such diversity, but it is to be found in the same group of states and often in adjoining states, where the character of traffic and conditions of trade are practically alike. Considering some of these provisions somewhat in detail, it will be seen first that great diversity exists in the organization of the various commissions. The number of commissioners varies from 1 to 5, it being 3 in the majority of the states. The term of office varies from two years to six years. No principle whatever seems to have been followed in choosing either the number of persons constituting the commissions or the length of their terms of office; neither the mileage of railway, density of traffic, nor the population being considered. The same conditions will be found in the provisions respecting the qualifications of the commissioners; 3 states definitely prescribe a standard of fitness; 4 have certain restrictions in regard to the number which can be of the same political party; no less than 23 of the 30 states having regularly organized commissions have no provisions requiring any special qualifications in the persons composing the commissions. In 15 of these 23 states the commissioners are appointed by the governor, leaving the door wide open for all sorts of partisan abuses.

Turning to the statutory powers and duties of the commissions, a similar lack of uniformity is seen. The regulative commissions, with few exceptions, have power to classify freight and passenger traffic, to make, revise and alter rates, and to enforce decisions and orders, while the advisory commissions generally lack these powers. The diversity exists in the lack of uniformity in exercising these powers. For example, it is doubtful if any two commissions, having the power to classify freight and passenger traffic, use the same form of classification. This diversity is further increased by the use of non-legal classifications of the several railway associations for that purpose. All of the commissions are required to report either annually or biennially, and, owing largely to the efforts of the Interstate Commerce Commission, the fiscal years of all but five of them end on June 30. The practice in regard to the inspection of roadbed and track is also quite uniform. In 12 states, however, the frequency of such inspections is left to the discretion of the commissions, with the result that no inspection worthy of the name is ever made, or, at least, made often enough to be of any practical use. In fact the inspection of permanent way as ordinarily made, even where it is required annually, is ordinarily a farce, and savors more of a "junketing" tour than of a faithful performance of duty. The table also shows that the laws are sadly lacking in provisions requiring the commissions to examine into and report upon the causes of accidents; a provision not only important, but absolutely necessary to place the responsibility where it belongs, as any one familiar with the "findings" of the Dogberrys composing the average coroner's jury, will admit.

A study of the general railway laws reveals the same lack of harmony. Provisions prohibiting discrimination exist in all of the states having regular commissions, and all but 8 of these states have laws requiring rates to be posted. In other respects the laws are not uniform.

It is unnecessary to go into further details, as enough has been said to show that uniformity and harmony in our railway laws are decidedly lacking. We may more profitably consider: (1) What are the results of this lack of uniformity in the dealings of the railways with the public? (2) What means are the most feasible and potent to bring about the legislation necessary to secure uniformity?

A very natural result has been that the railways, finding the discrimination caused by so many diverse laws detrimental to uniform operation, have resorted to underhand methods to evade them. The discrimination between different railways which practically results from this diversity of legislation is most graphically shown by the map. Let us take, for example, the provisions limiting freight and passenger rates, and apply them to the Pennsylvania and Chicago & Northwestern systems, as we do in the table below. We have chosen these two provisions, first, because their enforcement has been the cause

of some of the bitterest controversies in the history of railway legislation, and secondly, because their effect upon interstate traffic is not qualified by the federal law. The two railway systems chosen are fairly representative of the sections of the country where questions of railway regulation have been most prominent, and, moreover, the conditions of trade and character of traffic in the states covered by each are practically the same.

Table Showing the Diversity in the Laws Limiting Freight and Passenger Rates in the States Covered by the Pennsylvania and Chicago & Northwestern Railway Systems.

| —Pennsylvania system.— | | | —Chi. & Northw. system.— | | |
|---|---|---|---|---|---|
| States: | Pass. rates. lim. | Frt. rates. lim. | States: | Pass. rates. lim. | Frt. rates. lim. |
| N. Y. | Yes | No | Ill. | (c) Yes | (c) Yes |
| N. J | Yes | No | Wis. | (d) Yes | (d) Yes |
| Pa. | No | No | Ia | Yes | (c) Yes |
| Del. | No Com. | No Com. | Minn | No | No |
| Md. | No Com. | No Com. | N. Dak. | No | No |
| Va | Yes | Yes | S. Dak. | No | No |
| Ohio | No | Yes | Neb. | Yes | Yes |
| Ind. | No | No | Wyo. | No Com | No Com. |
| Mich. | (a) Yes | (b) Yes | Mich | (a) Yes | (b) Yes |
| Ill. | (c) Yes | (c) Yes | | | |

(a) Two cents per mile. (b) By car load. (c) In hands of commission. (d) On three railways.

The anomaly is only increased by extending this comparison. Such a condition of affairs is unfair and unjust to the railway corporations, and its certain natural effect is to provoke their hostility. Moreover, it deprives the railways of an incentive to obey the laws even in states where they are wise and wisely enforced, it encourages discrimination and bribery, and impairs the usefulness and influence of the commissions. At the same time the importance of the work done by these commissions must not be forgotten. Imperfect and hampered by lack of power as they are, they have been the means of settling many of the contested questions which have risen between the railways and the people, and they have formulated a body of opinion which will serve as a basis for future legislation.

The most potent and feasible means of bringing about harmony and uniformity in railway legislation Mr. Clark considers to be co-operation between the various commissions, and the benefits of the progress already made in this direction speak for the correctness of this conclusion. For the last three years the Interstate Commerce Commission and delegates of the several state railroad commissions have held joint conventions at Washington annually. While these conventions have been in a great degree informal and the attendance voluntary, a large amount of work has been done and several valuable reports presented. A fourth convention is to be held during the present month, and the following lists of subjects, upon which reports are to be made, will show the scope of the work being done: (1) Congressional Action in Regard to Safety Appliances; (2) Reasonable Rates; (3) Uniformity of Railway Accounts; (4) Discrimination from Use of Private Cars of Shippers; (5) Railway Legislation. The good results of these conventions are already seen, in the adoption of a uniform date for closing the fiscal year, in the increased number of commissions using the form of report recommended by the Interstate Commerce Commission, and in other less noticeable directions.

Considering the good results of the progress already made it can hardly be doubted that co-operation is most potent to bring about the harmony and uniformity required to make our railway laws just and useful. It is only following out the practice of the railways themselves. No one questions the benefits of such organizations as the Roadmasters' Association of America, the Master Car Builders' Association, and the American Master Mechanics' Association to the construction and mechanical departments of the railways, or of the Association of Railway Accounting Officers to the financial department. The purpose of the convention of railway commissioners is the same; to secure an interchange of ideas, uniformity and harmony.

But to secure the best results from these conventions of commissioners one step more seems highly important. The organization should be placed on a permanent basis by converting itself into an association having fixed laws and times of meeting, instead of a mere convention called at will. At present all its proceedings lack the stamp of formality and authority, and their influence is consequently impaired. It is to be hoped that the necessary steps to secure formal organization will be taken at the coming convention. If this be done, an organization will have been formed, which, if permitted to develop as experience points the way, and if supported by enlightened public sentiment, will do much toward solving the present "railway problem." Perhaps, if such an organization were once formed, some things which the several states now do at some disadvantage, like the collection of special statistics, might be turned over to the statistician of the Interstate Commerce Commission, so as to need doing but once, instead of twice.

## LETTERS TO THE EDITOR.

### THE AUSTIN DAM "CABLEWAY."

Sir: On the first page of your issue of March 26, you say: "The Austin Dam, Texas, cableway, before noticed by us as the longest single span of wire cableway in the world, i. e., 1,350 ft., we find not to be such," and you refer to your issue of March 21, 1891, where you describe a wire rope tramway having a span of 1,935 ft.

The word "cableway" has been adopted by the Lidgerwood Manufacturing Co. as a short term for what was previously called "cable hoisting and conveying machine" in contradistinction from "wire rope tramway," "rope way," etc., etc. The word "cableway" does not occur in any dictionary that I have examined excepting the Century Dictionary, and there is defined as meaning "the same as cable railway."

I think you will agree with me that a cable railway cannot properly be called a "cableway" because the "rail" and not the "cable" is the "way." We have in every day use the words pathway, driveway, railway, trackway; and "cableway" would naturally imply that the "cable" was the "way" over which something passed. Again "cable" defines something larger than "rope" and so "cableway" should denote that the "way" (the cable) is larger than the "rope" in wire ropeways or wire rope tramways. (The Austin cable is 2 1-2 ins. in diameter, while the rope in ropeways is usually 1 in. to 1 1-4 in).

Inasmuch as the word "cableway" seems not to have had any general use before the Lidgerwood Co. used it, does it not seem proper to confine its use to the large "cable conveying device" and let the small wire rope "conveying" devices be still called "wire rope tramways."

The Lidgerwood Company claims that the Austin Dam cableway is the longest hoisting "cableway" now erected, and are well aware that the wire rope tramways have been made with spans as great as 1,935 ft. and many of them with spans of 1,500 ft. It must be remembered, however, that wire rope tramways convey light loads, a few hundred pounds per load, while the Austin Dam "cableway" hoists and conveys eight tons at a load. Yours truly,

New York, March 29, 1892. Spencer Miller, M. E.

(The Lidgerwood Co. has done well in introducing or adopting the word cableway to designate a cable which is stretched as a "way" over which rolling loads can move. But in attempting to restrict it to any particular form or size of cable, or to cableways which are also used for hoisting, they are simply attempting the impossible, and exposing the word when used in such sense to such misconstructions as that which they attempt to correct above. It is to be remembered that, although the word "cable" had originally the sense of a very large rope, usage is now diverting it largely into a word for very long ropes regardless of size, as witness, "electric cable," "cable railway," etc. Against this usage it is useless to contend. A new word to obtain acceptance must be largely self-explanatory, and therefore "cableway" must have the broad meaning given above, if it is to come into general use at all, and never can be restricted to mean any particular size of cable and be understood. If this generality in the term "cableway" be recognized, greater definiteness of meaning can be had by speaking of a "hoisting cableway," or a "1-in." or "2 1-2-in. cableway." In this way the word will be used hereafter in these columns. We may add in conclusion that the word "tramway" is synonymous with "railway," and hence to speak of a "wire rope tramway" is in effect calling a rope a rail.—Ed.)

## "NON-ARCING" METALS.

A discovery which promises to be of much practical importance in electrical work has been made by Mr. Alexander J. Wurts, and was described by him in a paper read March 15, before the American Institute of Electrical Engineers. In some experiments made in designing new forms of lightning arresters, a discharger was used consisting of three solid round brass rods, 1 in. in diameter and 1 1-4 ins. long, placed side by side with their axes parallel and air gaps of 1-16 in. between them. The line was connected to the two outside rods and the middle one was grounded. A piece of tinfoil was dropped in one of the air gaps to start the arc and a brilliant display of fireworks was expected. Instead of this a small spark no larger than a pea was the only result, and the arc was not maintained.

Mr. Wurts was inclined to ascribe this to the cooling effect of the metal dischargers upon the arc, and to test this theory determined to make much larger dischargers and also use a considerably larger current. The new dischargers were 2 1-2 ins. diameter and 3 ins. long, and were connected to a 3,000-light, 1,000-volt alternating dynamo. When the current was turned on and the air space was bridged, the metal bars were melted like beeswax in a great ball of fire, much to the experimenter's disappointment. Thinking, however, that there could be no harm in melting up the small discharger, previously described, in the same way, he placed that in the circuit and closed the switch. To his great astonishment the small discharger remained intact, and the spark which passed was hardly larger than before.

It was then learned that the small discharger was of brass, composed of copper and zinc, while the large one, which melted so quickly, was a copper-tin bronze. Various other metals were then tested. It was found that steel, hard copper, phosphor-bronze, aluminum-bronze and aluminum, would all maintain a brilliant arc. Zinc was next tried, and with a discharger of this metal it was found exceedingly difficult to maintain an arc. This was especially surprising, for who is there at all familiar with the properties of zinc who would have suggested this metal as one likely to resist an electric arc of 1,000 volts in this manner? Tin and nickel were then tried, and the former gave the most brilliant arc of all the metals tested. Antimony was then tried, and notwithstanding its low melting point it gave no arc. The theory now advanced to explain the phenomena was that with the metals that do not allow the arc to be maintained, there is formed at the instant the arc is started, an oxide of the metal which, becoming instantly volatilized in the intense heat of the arc, chokes up the air-gap with vapors of high resistance, and presents an effective barrier to the further passage of the current. With metals that do maintain the arc, instead of the vapor of the oxide of the metal, there is formed a pure vapor of the metal itself, and this offers comparatively no resistance to the passage of the current. It will be noted that all the above tests were made with the alternating current. The direct current was next tested; and while an arc was formed with all the metals, it was very small and quiet with the zinc and the antimony.

A curious phenomenon connected with zinc and antimony is that there is less tendency to maintain the arc when the air-gap is small. Using an air-gap 2 ins. long and a 1,000-volt alternating current, the arc when once started will be maintained. At 1-2 in. or 1-4 in. the arc tends to maintain itself; but at 1-32 in. there is only a small spark and the circuit is instantly interrupted.

Further investigations were made to determine what other metals would act like zinc and antimony, and it was found that all available metals belonging to the same chemical groups acted in the same way. Cadmium, magnesium, bismuth and mercury in the form of a copper amalgam, were all tested with successful results, the last named proving even better than the zinc or antimony.

The discovery has already been made use of by Mr. Wurts in the design of a special form of lightning arrester, composed of non-arcing metal. It seems likely to prove of practical importance in many forms of electrical apparatus.

## PNEUMATIC FOUNDATIONS OF THE AARE BRIDGE, AT COBLENTZ.

As described in a late issue of the "Schweizerische Bauzeitung," this bridge is being constructed across the river Aare near the Coblentz station of the Stein-Coblentz Railway. As shown on the plan,

Fig. 1, there will be five spans, of a length not stated, crossing in a curved line a small island in the river, The piers II. and III. are located on the island, while piers I. and IV. and the lefthand abutment are founded in deep water. The embankment shown to the left is to be continued out to the abutment

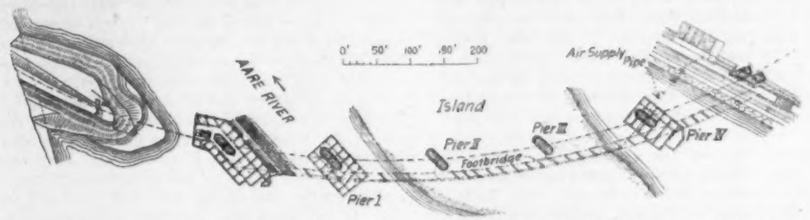
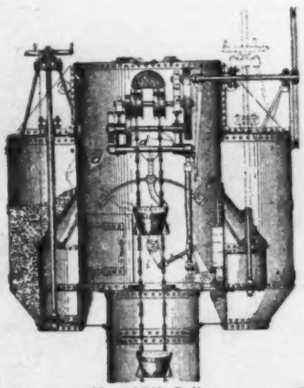



FIG. 1. PLAN SHOWING LOCATION OF THE AARE BRIDGE, NEAR COBLENZ, SWITZERLAND.



SECTION C D.

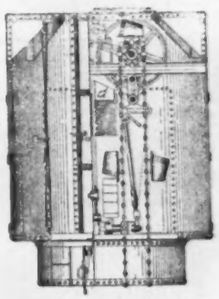


FIG. 3. SECTION A B.

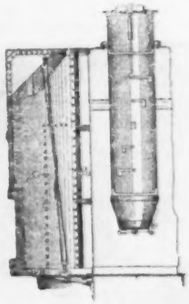


FIG. 4.

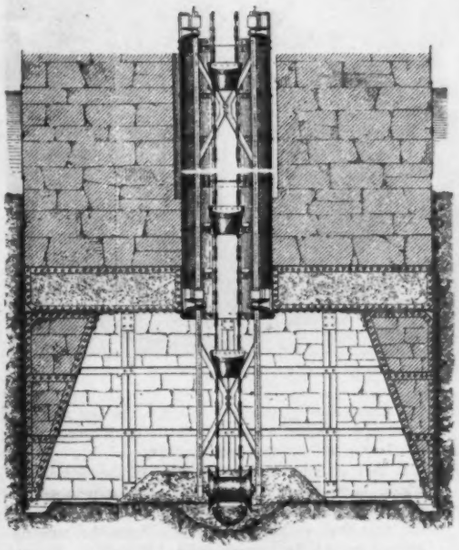


FIG. 2. SECTION THROUGH SHAFT AND CAISSON.

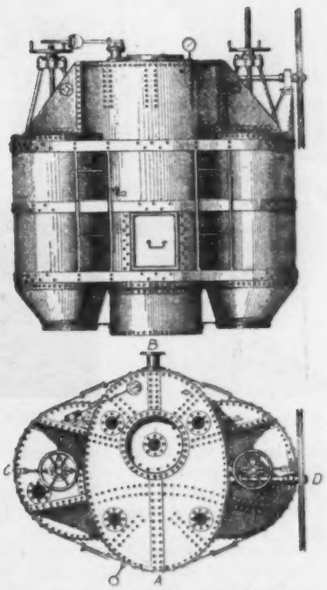



FIG. 5. ELEVATION AND PLAN.

Borings showed the rock to be very irregular in its surface, and the overlying bed of packed gravel and boulders made it impossible to drive piles at the right hand abutment as was first planned. A pneumatic foundation was used at this point, similar in general form to those described for the piers.

The working-chamber of the pier caissons was made of iron, as shown in Fig. 2, and the double roof was filled with concrete. The shaft leading to the air-lock was elliptical in form, and in one end was an iron ladder. The air-lock was of the usual modern European type, with some novel features in the handling of the material. This material was coarse gravel and cobblestones, and when picked loose it was thrown by the workmen under the shaft and hoisted to the lock by an endless chain of buckets, operated by an engine outside the lock, and passing over drums at the top and bottom of the shaft. As the filled buckets arrive at the top of the hoist they are automatically dumped into a collecting bucket (d, Fig. 3). This collector is attached to a pivoted arm, better shown in Fig. 2, and by means of this arm is thrown over to either side and emptied into the side discharge-locks. The latter, when fully charged, are emptied by a bottom gate operated from the top of the lock by a rod and worm-gear.

When the cutting edge of the caisson had reached the required depth and the bottom was cleaned up, the chain of buckets was removed and the concrete-lock (Fig. 4) was substituted. This was simply a cylinder with top and bottom gates, and was located in the air-lock. The text does not describe how the concrete was transferred to the working chamber; but it was apparently let drop to the bottom, and then placed by hand about the chamber until this was sealed against water. The concrete-lock was then removed and the remainder of the work of filling was done in the open air.

Much time was lost at pier I., and the left abutment in leveling off the rock, where the difference in level was nearly 6 ft. But the foundation work was completed in eight months. The respective depths of foundation below low-water mark were as follows:

| | |
|---|---|
| Left abutment, on rock | 20 ft. |
| Pier I., on rock | 29 ft. |
| Piers II., III., IV., on gravel and cobble | 39 ft. |
| Right abutment, on gravel and cobble | 33 ft. |

The masonry surrounding the caissons was granite with limestone backing, the stones used being large and averaging 6.5 cu. yds. in volume.

## TYPESETTING BY MACHINERY.

The art of setting up and printing from moving type, substantially as it is done to-day, was a well established art when America was discovered in 1492, just 400 years ago; and has been since, we need not say, in constant and increasing use. Since that date almost every modern art has been transformed, and most of them have been invented, but every branch of the art of printing has been slow to change, and typesetting the slowest of all. There is probably no other branch of manual labor of equal importance which is still performed with so little aid from machinery. The compositor of to-day sets type by picking the letters one at a time from their respective compartments in a wooden "case" just as his predecessors did 100 or 400 years ago. Modern improvements in printing presses are now an old story; but with few exceptions, typesetting is everywhere done by hand.

Now the setting of the type, or composition, is one of the chief expenses in connection with the production of the printed sheet. A page of Engineering News in the size of type (minion) in which this article is set contains 10,700 ems, and the labor of setting it up would cost at 40 cts. per 1,000 ems (the rate fixed in New York by the compositors' union) about $4.28. To set up such a page would take a fair compositor from 9 to 12 hours.

For over half a century inventors in various countries of the world have struggled with the task of devising machines to set and distribute type, but it is only within the past 20 years that typesetting machines have been used at all, and only within the past three or four years that any machines have been perfected which seemed likely to come into general use as a substitute for hand work.

Not long ago the attention of the managers of Engineering News was directed to this subject, and after careful investigation it was determined to use machine composition in future in setting the pages of this journal. Beginning with our issue of March 19 an increasing proportion of the paper has been set by machines; and in the present issue all but about a page of matter, which has been "on the galleys" for some time has been set by machine.

For this reason, and because it is a matter of great general interest we have thought it worth while to give some account of the development of composing machinery, with a description of the remarkable machines which have replaced hand composition in the work on this journal. We may say here that the machines we have in use are not properly typesetting machines, but type casting machines, a distinction which we shall make clear further on.

The invention of composing machines is a work in which hundreds of inventors and mechanical engineers have at some time or other been engaged. Some degree of success was long ago attained by several different methods; but to achieve mechanical success and to achieve practical success are two different things. the reason why machine composition at the present day promises to come into general use is not alone because of more ingenious machines, but because of the marvelous improvement in mechanical engineering which has made manufacturing processes a success that would have been a total failure a score of years ago. At the present time there are probably 500 composing machines in daily use in perhaps 75 different printing offices, and their use is very rapidly extending.

A complete record of the progress in typesetting machines would fill volumes; it is the design of the present paper merely to give a general idea of the principal problems presented and to show how they have been solved in the machines now prominently before the public.

The ordinary printer's case contains three complete alphabets (capitals, small capitals and "lower

case" letters), making 78 characters. Marks of punctuation and reference, spaces to separate words, accented letters, etc., increase the number of "sorts" to about 140. The italics are in a separate case. In a typesetting machine these various letters are arranged in "magazines." Instead of standing before a case and picking letters from its various compartments with a travel of his hand through the air of from 1 ft. to 6 ft. for each letter, the compositor sits at a keyboard similar to that of a typewriting machine, and touching key after key brings down letter after letter, right side up, to form a continuous line of type.

Of course a keyboard of 140 characters would be practically out of the question, but many of the characters are used so seldom that they can be either dispensed with or added to the line by hand when they are required. Nearly all typesetting machines dispense with small capitals, for instance, and the number of characters is finally reduced to about 75. The Thorne newspaper machine, however, has 120 characters on its keyboard, which includes an alphabet of small capitals.

Practically all the typesetting (i. e., non-casting) machines ever in use set the type in a long, continuous line, and it must be divided up into separate lines as long as the width of the column, and each line must be "justified," or filled out to exact length, by putting in "spaces" to increase or diminish the width between the words. Where a long word comes at the end of the line it must be split and a hyphen inserted. Manifestly, no machine can be made to space this line wide and that one narrow, and to divide words properly which break on the end of a line. Many attempts at mechanical justification have been made, some of them of marvelous ingenuity; but so far as the machines which actually set type are concerned, no practical means of mechanical justification has yet been found. The typesetting machines at present in use, therefore, require two operators, one to manipulate the keyboard and one to justify the lines. Manifestly the speed of the machine cannot be greater than that of the slower of the two operators; and it is almost always the case that the justifier cannot keep up with the typesetter.

After justification, the most difficult task before the inventors working in this line has been the distribution, or the sorting of all the types after use, placing each letter and character in its proper receptacle. In distributing by hand a speed is attained over three times as great as in setting by hand, or 3,000 to 4,000 ems per hour. The opportunity for saving by the use of machines is, therefore, much less than in the case of setting. On the other hand in setting type by machinery the types are taken from magazines in which they are arranged right side up in a regular row as they would be arranged in a line of type, save that all letters of one sort are together in one magazine. Hand distribution leaves the type in each compartment of the printer's case arranged higgledy-piggledy. It is evident, therefore, that type which is to be set by machinery must be also distributed by machinery.

Distributing machines have been of two classes, the first, which was a favorite with early inventors, was worked with keys in a similar manner to the typesetting machine. These keys moved switches in a network of channels so that depressing a key caused a passage to be opened, guiding the type to its proper receptacle. The operator had to read the type and depress key after key and was little less liable to make mistakes than in hand distribution. A man working one of these machines could distribute hardly faster than he could distribute by hand; but the reason why hand distribution was fatal to the success of mechanical composition has already been explained.

All these machines have now been superseded by the automatic method of distribution, in which each type has notches cut in the back, corresponding to projections in the channel in which it belongs. The type after use is made to move along the face of the channels and each letter will pass every channel until it comes opposite its own, where the projections fit the notches and the type drops into its place.

It is a noteworthy fact that the first patent ever issued on typesetting machinery was issued to an American, and the two machines which at the present time have reached a wider use than has ever before been attained by any system of mechanical composition are both of them American inventions.

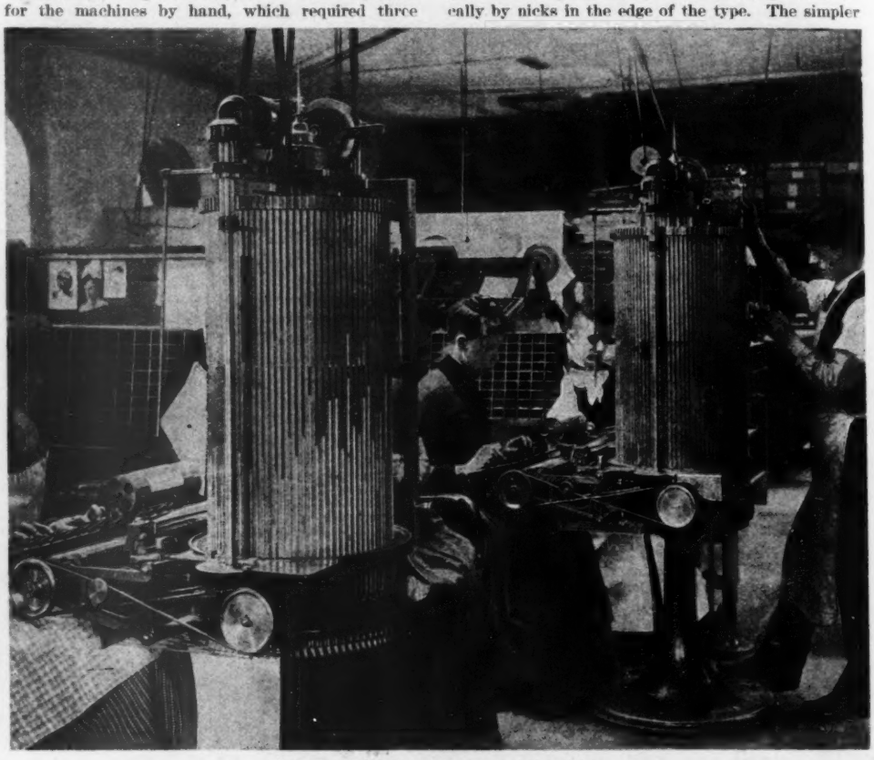
Queerly enough, however, although Dr. William Church, in whose name the first patent on a typesetting machine stands, came from Connecticut, that state of many inventions, his patent was taken out in England, in 1822. His machine was designed to cast type and leave them in reservoirs, and they were set from these reservoirs. After use the type were remelted, the inventor in this way getting around the problem of distribution. It is most interesting that the very first inventor in this line should have worked in the direction of type casting, an idea which, though long ignored, has been lately taken up with wonderful success.

Evidently Church was a man ahead of his time, for it was not until a score of years had elapsed that the issue of patents began to be numerous. In 1840 James H. Young, of England, completed a machine which is said to have set type at the rate of 13,000 "sorts" per hour, but the type had to be justified, distributed, and (presumably) set in the magazines for the machines by hand, which required three persons to keep up with the machine operator. The first distributor patented in America was by Frederick Rosenberg, Sept. 9, 1843. The first English patent on a distributor was to Etienne Robert Gaudens in 1840.

After this among prominent American inventors follow the names of Mitchell, Alden, Felt, Brown, Westcott, Kastenbein, Paige, Richards, Burr, and in recent years McMillan, Thorne, Rogers and Mergenthaler. Among the prominent foreign inventors who achieved more or less success were Hattersley, Mackie and Fraser, in England; Sorensen, of Denmark; Fischer and Von Langen, of Berlin, and Delcambre, of France.

The commercial success reached by some of these machines was quite remarkable. As long ago as 1866, Horace Greeley, whose experience as a printer gave him a great interest in inventions of this sort, had the Alden machine at work in the New York "Tribune" office. Ten of the Mitchell machines, invented in 1853, are said to have been in use at one time in a single office. In 1872, the "Times," of London, began the use of the Kastenbein machines, and finally set the whole paper upon them. The Fraser and Hattersley machines were considerably used in England at one time. In 1880 the Burr machine was tried in the New York "Tribune" office, and three machines were in use there for some years. At the present time six of these machines are still in use by the Burr Printing Co and ten by George Munro, of "Seaside Library" fame. In 1884 the Fischer and Von Langen machine was in use in the office of the Cologne "Gazette," and attempts were made to introduce it into England. All these successes, however, have been far outdone by the recently invented Thorne and Mergenthaler machines. There are about 150 of the Thorne (typesetting) and about 350 of the Mergenthaler (type casting) in use. The Mergenthaler is the machine used by this journal, and from which this article was set up.

But the inventors who have reached the point of seeing their machines in practical use are but a few out of the many. The ground has been so thoroughly worked over that it would seem as if every idea of possible value in this connection has been worked out by some one or other and tested in practice. In the typesetting machines proper, however, the simplest methods have proved, as a rule, the best. Thus the distributors worked by a keyboard have been superseded by those working automatically by nicks in the edge of the type. The simpler the mechanical connection between the key and the type pusher which ejects a type from the magazine the better satisfaction has it given.



THE THORNE TYPESETTING MACHINES.

It may of interest to note some of the difficulties which have beset inventors of these machines at various stages of the typesetting process. One of the first was to have the letters from the various magazines set in proper order. Evidently, if the letter a is close to the point where the type is set and r is some distance away, a rapid operator in setting the letters r a might find that the a was set in the line before the r. Many machines obviate this by placing the mouths of all the magazines as nearly as possible equidistant from the point where they are assembled. In the Thorne machine, illustrated in the accompanying engraving, the types are held horizontally in vertical channels on the circumference of an upright cylinder, and are pushed out onto a rapidly revolving plate, which whirls them around to the point of exit too fast for transposition to occur. In Mitchell's machine the types were pushed out onto a series of parallel endless belts, moving horizontally. These delivered the type onto another horizontal belt moving obliquely to the first, and by this artifice an approximately equal time of travel of each type from the magazines to the setting point was secured.

The justification, as stated above, has been and

still is the chief defect of typesetting machines, an extra operator being required to perform it. Everything has been done to facilitate the justifier's work in the way of automatic tools and appliances, but his speed is still inferior as a rule to that of the operator on the keyboard. The Thorne Typesetting Machine Co. informs us since this article was in type that while this was true until lately, at present the justifier can keep up with the setter except on very narrow measure and where book spacing is required. The only typesetting machine proper which ever was made to justify successfully was the Paige machine, of Hartford; and this, though a triumph of mechanical ingenuity, was too expensive and complicated to be a practical success.

An ingenious idea worked out in one direction by Mackie, of England, and in another by Charles W. Felt, of Salem, Mass., was to perforate ribbons of paper by a keyboard action. The former used three perforated strips to operate the typesetter proper. Mr. Felt attempted to perforate a paper ribbon at the same time the type was set, and to use these perforated ribbons to work the levers of a distributing machine. The operations of justification and correction of errors in the original setting of course made Mr. Felt's idea impracticable.

We have thus far spoken chiefly of machines which actually set type; but very numerous attempts have been made by inventors to do away with the use of type altogether. A favorite idea has been to form a matrix by punching with dies into metal or papier-mache, thus making a mold from which a stereotype block can be cast. A machine of this sort, which after absorbing an immense amount of capital, proved a complete failure, was described in our issue of April 13, 1889. Some of the reasons why this idea is impracticable may be of interest. It is not generally realized how great mechanical accuracy is necessary in producing a printed page. The letters must not vary 0.002 inch of being in exact line with each other, or the lines will be noticeably crooked. Adjacent letters must not vary 0.003 inch in height, or there will be noticeable variations in their impression on the paper. Thus in what may be called the matrix-making machines the punches must move to their places in the line with mathematical accuracy, and must punch the letters to uniform depth, notwithstanding variations in hardness of the material. Suppose the machine is so accurately made that it succeeds in doing this at the start, the wear of the joints will soon cause "lost motion" in the levers which move the punches. Again the punches for the frequently used letters like e and t will be worn low while letters like q and z still retain their original height. In lieu of the ordinary process of justification, the copy for the matrix-making machine was specially written on a typewriter having an attachment for counting the "units" in each line. At the end of each line the typewriter wrote the number of units that line was over or under length, preceding it by a plus or minus sign. Of course this necessity for the special preparation of copy and the fact that the operator had to keep sums in mental arithmetic in his mind while he was reading copy and fingering the keyboard, were highly objectionable. Perhaps the most serious practical fault of these machines, however, was the impossibility of corrections. The matrix was punched in sheets, and the touching of a wrong key, an error in the copy, or any one of a thousand things might cause an error which could not be corrected.

Still other mechanical defects, especially with machines which punched metal instead of papier-mache, were the deforming of one letter by the punching of the next adjacent, and the fact that the metal bars had to be melted and recast or else thrown away after one using.

What probably led to the invention of this type of machines was the familiar process of stereotyping, in which an impression of the page of type is taken in moist papier-mache, and a cast is made from this matrix in stereotype metal. From the plate thus formed the printing is done. In such an operation a practically perfect reproduction of the original page of type is made, and the troubles above noted with the scheme of impressing each letter separately do not appear.

Returning to the machines which are now prominent before the public, the two typesetting machines now on the market are the Thorne and McMillan. The Thorne machine, illustrated herewith, which is a combined setter and distributor, consists of an upright cylinder with vertical channels all around it, each containing a line of type. The lower half of the cylinder is stationary, and its channels contain the distributed type. The upper half of the cylinder turns with a step-by-step motion, and its channels contain the lines of type to be distributed. The motion of the upper cylinder is such as to bring its channels opposite those of the lower, when an instant's pause occurs, permitting any type which is opposite a channel in the lower cylinder, whose projections correspond to its own nicks, to drop down. Then the cylinder is rotated one step, bringing the channels again in coincidence. The type is set from the channels of the lower cylinder; the lowest type in a channel being pushed out radially when the operator depresses the key which governs it. A rapidly revolving plate whirls the type around and delivers it on an endless belt which carries it to a setting up mechanism. Here the type is turned upon its feet and added to the continuous line of type, which is slowly pushed along toward the justifier as type after type is added.

A chief fault of the Thorne machine is the breakage of type, a fault which has attended all or nearly all systems of mechanical distribution. As one of the lower channels is filled nearly full, another type dropping in is likely to project a little above the top of the stationary cylinder, and will be sheared off when the upper cylinder revolves. The attendant in charge of the distribution has to avoid filling the channels too full, but on the other hand he must not let them become so nearly empty as to endanger errors from the running out of sorts. In general, one man is required for every two or three machines in use to look after the distribution and keep the machines in working order.

One would be risking little, however, in saying that the Thorne machine is on the whole the most meritorious machine for setting type ever invented. The combination of the typesetter and distributor in one machine is a most important point, and although the working of the distributor is not wholly satisfactory, it must be remembered that the great variation in the size and weights of type, a thin space being hardly a tenth as thick as a capital W, make the problem of its automatic distribution a most difficult one.

The manufacturers inform us that the breakage of type has been very much reduced by recent improvements in the machine, and is now only a small percentage of the saving effected by their use. The "Philadelphia Press" uses 20 Thorne machines, and they are in use on a half dozen other papers in this country, and nearly twice as many abroad. They are still more extensively used for magazine and book work.

The McMillan machine is a more recent invention than the Thorne, and is only beginning to come into use. Three McMillan setters and one distributor are in use in the "Evening Post" office in this city. The setting machine is simple and compact. The magazines are removable, being exchanged for full ones as fast as they become empty. The distributor consists of a horizontal wheel with radial channels in which the type to be distributed is placed. The frame surrounding the wheel contains other radial channels having projections corresponding to the nicks in the type. Magazines are placed radially in connection with these outer channels. When the wheel slowly revolves, the letters pass from the channels of the wheel into the outer channels whenever a letter comes opposite the one which fits its nicks. At present the distributor leaves the thin letters in the magazine somewhat disarranged, and they have to be turned right side up and trued up by hand. The necessity of stopping the machines to replace the empty magazines with full ones detracts something from the speed of the machines.

We reserve for another issue the description of the Mergenthaler or Linotype machine, which is now in use on Engineering News.

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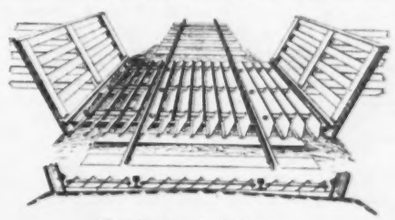
**Nicaragua Canal stock, according to good report, has been secured by Messrs. John W. Mackay, Austin Corbin, H. M. Flagler, Andrew Carnegie, H. O. Armour and Cornelius N. Bliss, in large blocks. When capitalists and men of affairs like these take a live interest in the ship canal, early construction work may be looked for.**

## THE STANDARD CATTLE GUARD.

We give herewith an engraving which affords a better idea of the construction of this guard than did the description which we have heretofore given. We publish it that the following record of some tests made by Mr. J. Collom, Roadmaster of the Monroe Division of the Lake Shore & Michigan Southern Ry., may be more readily comprehended. Mr. Collom says, in his letter describing the tests:

On Monday, February 22, I made a test of the Standard cattle guard, which was as much as possible like the test made last fall at Indianapolis, and described in Engineering News of Dec. 5, last. In fact I believe it was a much more severe test than those described. On one side of the guard I placed a pile of hay and stalks, and on the other side of the fence and guard I collected about 12 head of cattle of different sizes and ages. I kept the cattle close up to the guard by herding them with eight men for about 30 minutes and in that time not one of them crossed. One after another they would step on the guard and attempt to



The Standard Cattleguard.

cross, and would immediately step back again. We then tried to drive them across, but did not succeed after making repeated attempts. Seeing I could not get them over in this way, I turned the herd, all but four, through the fence to the hay on the inside and allowed them to eat. Again I brought the men around the four remaining cattle and herded them close up to the guard, but could not get them to go over. Finally I determined to force them over as they would be forced through a pit guard, just to see what the result would be. One of the most frisky made a lunge and jumped the guard. After some time one other was forced on and floundered across; then another went over in much the same way; three of them went over under the pressure, but I believe they would have crossed any other guard, pit guard included, under the same test. The last part of the test, I do not think was fair, because the stock was absolutely forced across, and it was plain that under ordinary circumstances the stock would not have attempted more than a step on the guard.

This test would certainly seem to have been a fair one, and to have been well sustained. The slanting of the plates in this guard seems to us a good idea, as likely to add a new deterring influence to that which naturally appertains to slats of any kind. The total weight of the guard complete is 400 lbs., and its cost $25. Mr. B. F. Haddock is general agent for the guard, 39 West Washington St., Chicago, and from him further information can be had.

## SPARK ARRESTERS ON ENGLISH LOCOMOTIVES.

Spark arresters for locomotives, as known in England, are apparently of a very crude and inefficient character. In our issue of Oct. 24, 1891, we gave an account of a suit brought against the Caledonian Railway, of Scotland, for damages for a fire claimed to have been caused by a spark from a locomotive, in which a verdict was given against the railway company. The company claimed that its arrangements for complete combustion were so perfect that if sparks were emitted which reached the ground while glowing, either the engine driver was at fault or the coal was very bad, and it was also claimed that the use of spark arresters was being abandoned by the principal English railway companies as interfering with the operation of the engines. The court however, after hearing the professional evidence, could not see why they should not continue to be used, or why they should not tend to reduce the risk of fire. The decision has now been reversed in another court, as will be seen by the following interesting extract from the "Railway News," of London. It was admitted by the court that the fire was caused by a spark from a locomotive, but the reversal was made on the ground that the railway

company was not liable, it having employed the best means to prevent fire. A similar case brought against the Great Western Railway, in which the verdict was for the railway company, was noted in our issue of Feb. 20, 1892.

An important point in favor of railway companies has just been settled in the Court of Session, in Scotland, where a bench of four judges, including the Lord President of the court, unanimously reversed a decision given against the Caledonian Railway by the Judge of First Instance. The case arose from a claim for damage by fire made by the Port Glasgow & Newark Sailcloth Co., and amounting to $6,000, for the destruction by fire, in June, 1890, of a flax store belonging to that company, and situated close to the railway line in Port Glasgow. The railway company denied that an engine spark had ignited the flax, but all the judges held the fact to be fully proved by the evidence, so that the only question was as to the liability of the railway company. Reversing the decision of the judge below, the four judges held that the liability did not attach. It was part of the case for the sailcloth company that the railway had failed to use adequate appliances to prevent danger from engine sparks, and in particular, that their engines were not fitted with a "grid" or spark arrester.

The question thus, it will be seen, became of great importance, because, as was fully showed by Lord M'Laren, who gave the leading judgment, this "grid" or spark arrester is now only used in locomotives of old type and of slow speed. In the engines now constructed, where greater speed is attained, the presence of a grid would arrest the draught, and it has been sought to provide for the prevention of sparks by a more equable draft and better consumption. This was fully brought out by railway engineer witnesses, and the court had really to determine the question whether a railway company was to be prevented from using an improved and speedier engine merely because of danger from fire through the absence of the grid. There was no evidence to show that since the newer kind of engine had been brought into use there had been an increase in fires caused by railway sparks, and the plea of the pursuers that the railway company had, by the use of such engines, increased the quantity of sparks given out, was met by the remark that there was no standard of frequency of spark emissions by which the past and present engines could be held to be regulated. Provided the engines were of the best construction and that the best means applicable to the type of engine had been adopted to prevent spark emission, and provided the risk was not greater than the Legislature had impliedly sanctioned in giving power to use locomotive engines, the defenders were not liable, and as these conditions were both held to be fulfilled, the court exonerated the railway company. It was remarked that if a better system of spark prevention were discovered, but was only applicable to engines going at 20 miles an hour, the company would not be bound to adopt it. The decision here given is in full accordance with English decisions on the same point, where it has been held that although the occurrence of a fire implies fault, and thus throws on the railway company the onus of clearing itself, no liability holds if the best means are shown to be in use to prevent fire.

Until recent years the spark arrester generally used on American locomotives was an arrangement of deflector and wire netting placed in the enlarged top of the diamond stack or chimney, and this of course caused considerable back pressure to the exhaust, while if not kept in good order the cinders would cut the netting and sparks would escape. Since the introduction of the extension front to the smokebox the diamond stack has been going out of use. The smokebox is made about 4 ft. 6 ins. to 5 ft. long, and is fitted with a deflector plate or netting, or both, which prevent the sparks and cinders drawn through the tubes from being drawn up the smokestack by the force of the exhaust. A valve and shoot at the bottom of the smokebox are provided for blowing out the cinders under or at the side of the engine. The exhaust pipe is in front of the deflector plate, and passes throught the horizontal part of the netting, and a plain, unobstructed pipe smokestack is used, placed on the boiler end of the smokebox. This is an efficient device, and as it offers no obstruction to the passage of the exhaust, it is successfully applied to fast express engines as well as to freight and ordinary passenger engines. The general arrangement of the extension smokebox will be seen by the drawings on the inset sheet in our issue of March 26, but in the engine there illustrated no wire netting is used, owing to the soft exhaust resulting from the compound system. Judging from the published notes on the damage suit above referred to, it would appear as if English locomotive engineers are not familiar with American practice in spark arresters.

## DRIVING LEVER AND VALVE MOTION OF THE JOHNSTONE DOUBLE-TRUCK COMPOUND LOCOMOTIVE.

We conclude our articles upon the very interesting compound engine designed by Mr. F. W. Johnstone, Superintendent of Motive Power and Machinery of the Mexican Central Railway, with a description and drawing of the novel type of driving lever motion and valve gear, for which we are indebted to Mr. Johnstone. As will be seen by our previous articles (Eng. News, March 12 and 26 and April 2) the engine has two boilers, with fireboxes set back to back, and a six-wheel driving truck and two-wheel pony truck under each boiler. Each truck has an independent set of four cylinders, working compound. The cylinders are attached rigidly to the main frame of the engine, and as the driving wheels are carried by a swiveling truck frame, a special arrangement of driving motion had to be designed, the operation of which is fully described by Mr. Johnstone in a communication which we print below:

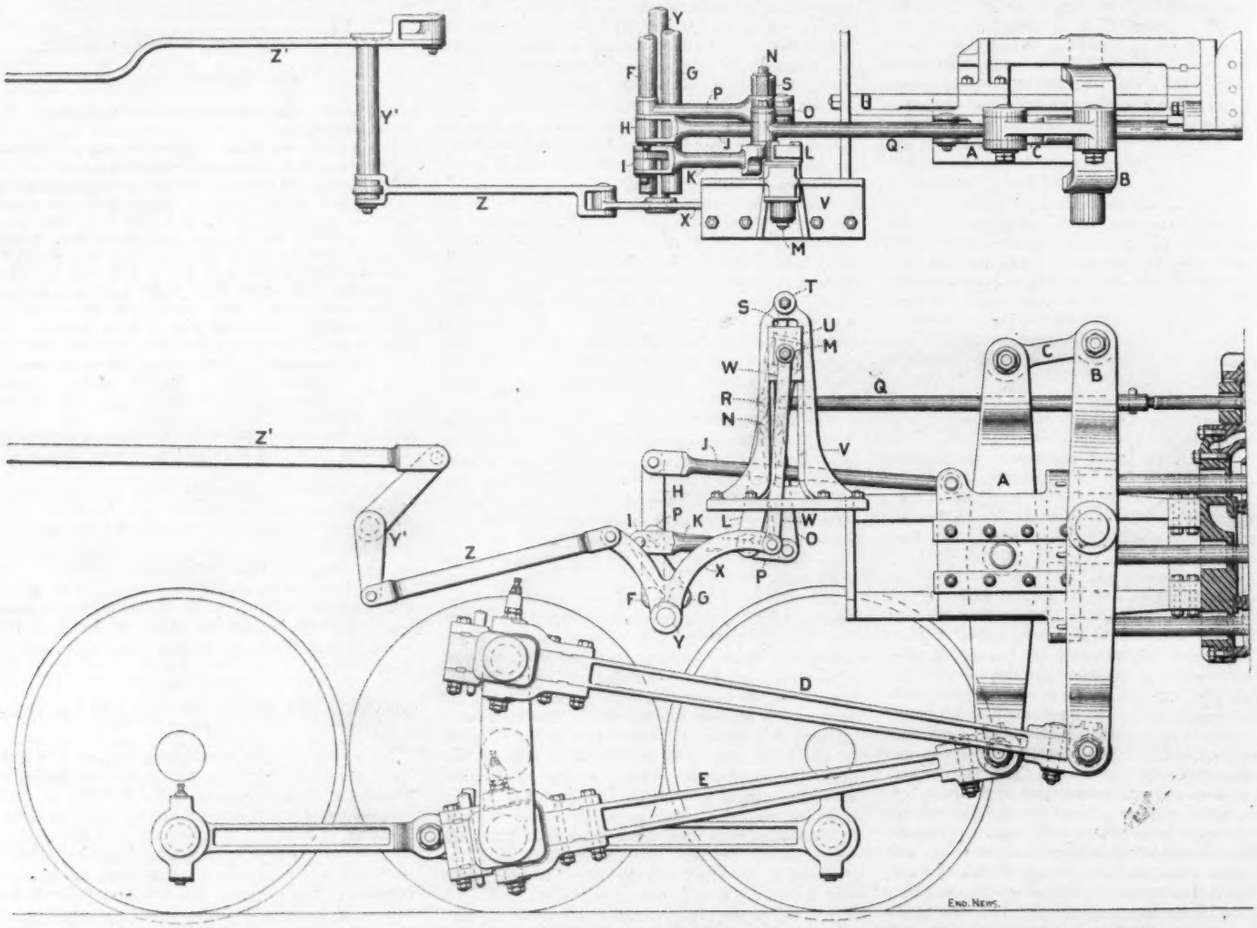
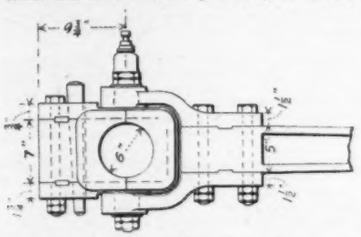



DIAGRAM OF DRIVING LEVERS AND VALVE MOTION OF JOHNSTONE COMPOUND LOCOMOTIVE; MEXICAN CENTRAL RAILWAY.

It will be seen by reference to the drawings that the action of the rocking levers is such as to admit of the drivers advancing or receding in adjusting themselves to curves without affecting the travel of piston and cross-head, and that the length of the connecting rod is constant, one end being solid and the other being fitted with strap and brass in the usual manner. The lever (A) which is attached to the cross-head, is pivoted in the center, and on straight track remains in a

perpendicular position, moving with the cross-head 24 ins. in its stroke. When the driving wheels set themselves to a curve this lever inclines forward or back, as the case may be, remaining in that position until the engine runs off the curve or the curve changes its radius. The fixed fulcrum lever (B) rocks in boxes attached to the guides and main carrying frame. The upper end of this rocking lever is attached to the upper end of the cross-head lever (A) by means of the rod (C), while the lower end carries the connecting rod (D), which couples to a pin on the return crank as shown.

The action of lever and rod attachment is as follows: Assuming the pressure on pistons to be 20,000 lbs., tending to move toward the rear end of cylinder, such pressure will be divided by the cross-head lever (A); 10,000 lbs. acting on rod (E) to rotate the drivers, and 10,000 lbs. on the upper tension rod (C) and fixed fulcrum lever (B). The upper arm of this lever being to the lower arm as 1 to 1.2, a pull of 8,300 lbs. will be




Knuckle-Joint on End of Main Rod; Compound Locomotive, Mexican Central Railway

exerted by the main rod (D) to revolve the driving wheels, but as the crank arm of main pin carrying the rod (E) is to the crank arm of pin carrying rod (D) as 1 to 1.2, the 8,300 lbs. pull of rod (D) will be equal to the 10,000 lbs. push of rod (E) to rotate the driving wheels. But what is of greater importance, the center of pin carrying main rod (E) is nearer the center line of the driving wheel frame than pin carrying rod (D), the proportion being as 1 to 1.2, for the reason that in curving the two main rods will be advanced or receded in this proportion, that is, the main rod (E) is advanced 1 in. while rod (D) advances 1.2 ins. It will be seen that the lower end of cross-head lever (A) will be moved ahead 1 in., and as the cross-head must not be disturbed, the upper end of this lever will be moved back 1 in., carrying the upper end of fixed fulcrum lever (B) 1 in. to the left; but as the upper end of this lever is to the lower end as 1 to 1.2, the lower end will move to the right 1.2 ins., or just enough to accommodate the forward movement of rod (D).

Again, as the center of main pin carrying the back end of rod (D) is further from the center of driving wheel truck than main pin carrying rod (E), in the proportion of 1.2 to 1, the pull of 8,300 lbs. exerted by rod (D) will be just equal to the 10,000 lbs. push exerted by rod (E), and the opposing forces will be brought into the same vertical plane, thereby counteracting any tendency of the main rods to force the driving wheels and their frames out of normal position.

The valve movement is taken entirely from the two cross-heads, no eccentrics or links being used. Two rocking shafts (F) and (G) extend across from one side of the engine to the other; on the right-hand side of the engine the shaft (F) has an arm (H), while on the left-hand side it has an arm of same dimensions as arm (I), and in like manner the shaft (G) having the arm (I) on right-hand side has a long arm like (H) on left-hand side of engine. Arm (H) is connected to right-hand cross-head by rod (J), and gives the full stroke motion to the valve on left-hand side of engine. In like manner, the left-hand cross-head by a similar connection with shaft (G) gives full travel of valve on the right-hand side by means of rod (K) which connects with the lower end of full stroke lever (L). As shown in the drawing the motion is in full forward stroke and lever (L) has as a fixed fulcrum the pin (M). At a point on lever (L) the pin (N) forms a fulcrum for the lead and lap lever (O), the lower end of which is connected to the right-hand cross-head by the rod (P) through lever (H) and rod (J), while the upper end is connected to the end of the valve rod (Q) by pin (R).

These levers and the valve rod are supported by the hanger (S) which swings on bolt (T), the lower end connected with pin (N).

The action of this motion is as follows: The right-hand valve, as before stated, gets its full travel from the left hand cross-head. The left hand cross-head is in its full back position throwing arm (I), rod (K) and lower end of lever (L) in position as shown. With pin (M) as a fulcrum, pin (N) is moved out of center and as the right hand cross-head is in its central point of stroke, the lower end of lever (O) is held in place by rod (P) and the upper end carried by pin (N). Its extreme upper end with pin (R) carries the valve rod (Q) and the valve to its extreme motion on the valve seat. To cut-off at any point in forward motion the block (U) is moved down the slot in casting (V), through the medium of rod (W), which connects pin (M) with arm (X) of the reversing shaft (Y), which in turn is actuated by the reach rod (Z), intermediate reversing shaft (Y') and reach rod (Z') connected to the reverse lever in the cab. As block (U) is lowered the leverage between the points (N) and (M) is shortened, the end of pin (M) which embraces lever (L) sliding down over the lever, drawing its upper end forward. Therefore, the lower block (U) is moved the less will be the travel of pin (N) and consequently the less will be the travel of valve and the sooner it will cut off in stroke of piston. Should block (U) be lowered until pin (M) coincides with pin (N) the motion of lever (L) due to the left hand cross-head will have no effect on the valve. But under these conditions the valve must have a movement equal to its lap and lead, and this it gets from the right hand cross-head through lever (O) and rod (P), with pin (N) as a fulcrum. To reverse the engine the motion block (U) is moved to a point below pin (N). The lead is constant at all points of cut-off.

The object of the intermediate reversing shaft (Y') is to regulate the amount of motion given block (U) on either end of engine, one engine always being in back motion while the other is in forward motion; and as the movement of block (U) from full stroke to central position, where pin (M) coincides with pin (N), is greater for the forward than for the back motion, these intermediate reversing shafts and arms are introduced to accelerate the motion of block (U) on the end of engine which is in forward motion and retard it on the end of engine which is in back motion.

## STATISTICS SHOWING THE PROGRESS AND PROSPECTS OF RAILWAY CONSTRUCTION IN THE STATES EAST OF CHICAGO.

(With Map No. 42.)

### CANADA.

Ontario and Eastern Provinces.—Existing Roads.

1. Adirondack & St. Lawrence.—Track laid in 1891, Valleyfield, P. Q., to the International line, 21 miles.

2. Bay of Quinte.—Surveyed. Tweed, north, 5 miles; Harrowsmith, east, 4 miles. Projected, 5 miles north of Tweed northwest, 55 miles. Ch. Engr., M. J. Butler, Deseronto.

3. Brockville, Westport & Sault Ste. Marie.—Projected, Westport, Ont., to Palmer Rapids, Ont., 80 miles. Ch. Engr., W. B. Smellie, Brockville, Ont.

4. Central Counties.—Track laid in 1891, Hawkesbury, Ont., to Glen Robertson, Ont., 21 miles.

Cornwallis Valley.—Projected, Centerville, N. S., to Middleton, N. S., 26 miles.

5. Grand Trunk.—Track laid in 1891, extension to Port Huron tunnel, 5 miles; Waterloo, Ont., to Elmira, Ont., 10.25 miles. Surveyed, at Perkinsfield, Ont., 4 miles.

Great Eastern.—Partly graded, St. Francis, P. Q., to Nicolet, P. Q., 17 miles. Projected, St. Gregoire, P. Q., to Chandlerre Junc., 67 miles. Gen. Man., C. N. Armstrong, Montreal, P. Q.

Great Northern.—Projected, Ste. Julienne, P. Q., to Joliet, P. Q., 9 miles. Ch. Engr., C. S. Baker, Montreal, P. Q.

6. Irondale, Bancroft & Ottawa.—Under construction, Irondale, Ont., to Bancroft, Ont., 35 miles.

7. Lake Erie, Essex & Detroit River.—Surveyed, Leamington, Ont., to Ridgeton, Ont., 45 miles.

Lower Laurentian.—Track laid in 1891, Riviere a Pierre, to St. Tite, P. Q., 13 miles.

8. Montreal & Ottawa.—Surveyed, Rigaud, Ont., to Ottawa, Ont., 75 miles. Ch. Engr., J. M. Shanley, Hudson.

9. Montreal & Western.—Track laid in 1891, St. Sauveur, P. Q., north, 8 miles. Under construction, 8 miles north of St. Sauveur, P. Q., to Ste. Agathe, P. Q., 10 miles. Projected, Ste. Agathe, to Chute au Iriquois, P. Q., 40 miles. Ch. Engr., J. H. Gardner, Ste. Jerome, P. Q.

Nova Scotia Midland.—Partly graded, New Glasgow, N. S., to Atlantic Coast, 60 miles. Pres., Herbert Redmond, 52 Broadway, New York city.

10.—Orford Mt.—Track laid in 1891, Eastman, P. Q., to Lawrenceville, P. Q., 10 miles. Projected, Lawrenceville to Kingsey, P. Q., 30 miles.

11. Ottawa & Gatineau Valley.—Track laid in 1891, 10 miles north of Hull, P. Q., to Wakefield, Ont., 10 miles. Graded, Wakefield north, 10 miles. Under construction, mile 30, north 30 miles. Surveyed, mile 50 to Maniwaka, 35 miles. Ch. Engr., W. D. Harris, Ottawa, Ont.

12. Parry Sound Colonization.—Track laid in 1891, Scotia, Ont., west, 20 miles. Surveyed, 20 miles west of Scotia to Parry Sound, 28 miles. Ch. Engr., S. R. Poulin, Emsdale, Ont.

Quebec Central.—Surveyed, Tring Station, P. Q., to Lake Megantic, 58 miles. Ch. Engr., E. Berryman, Sherbrooke, P. Q.

Stewiacki Valley & Lansdown.—Located, Brookfield, N. S., to Landsdown, N. S., 27 miles. Ch. Engr., L. H. Buck, Upper Stewiacke, N. S.

Temiscouata.—Track laid in 1891, Clairs to Connor's, N. B., 12 miles.

Tobique Valley.—Track laid in 1891, Pequanoque, N. S., to Red Rapids, N. S., 9.5 miles.

Torbrook Coal Co.—Track laid in 1891, Wilmont, N. S., to Torbrook, N. S., 3 miles.

13. Toronto Belt Line.—Track laid in 1891, belt line at Toronto, Ont., 8.5 miles.

Projects and Surveys.

14. Bracebridge Colonization.—Projected, Bracebridge, Ont., to Baysville, Ont., 11 miles.

15. Coburg, Northumberland & Pacific.—Projected, Cobourg, Ont., to Central Ontario Junc., Ont., 40 miles. Pres., Robt. Mulholland, Cobourg.

16. Kingston, Smith's Falls & Ottawa.—Projected, Kingston, Ont., to Ottawa, Ont., 100 miles. D. A. Givens, Kingston, Ont.

New Glasgow Coal and Iron.—Partly graded, Glasgow, N. S., to mines in Pictou Co., N. S., 10 miles.

Total.—Track laid in 1891, 151.25 miles. In process of construction, 162 miles. Surveyed or under survey, 281 miles. Projects of some promise, 458 miles.

### Maine.—Existing Roads.

17. Maine Central.—Skowhegan & Norridgewock R. R.—Under contract, Skowhegan to Norridgewock, 5.5 miles.—Knox. & Lincoln R. R.—Surveyed, Rockland to Camden, 8 miles.

18. Phillips & Rangeley.—Track laid in 1891, between Phillips and Rangeley, 5 miles.

19. Portland & Rumford Falls.—Under construction, Gilbertsville to Rumford Falls, 14.4 miles. Ch. Engr., Parker Spofford, Bucksport.

20. Sebasticook & Moosehead.—Surveyed, Hartland to Athens, 10 miles.

Projects and Surveys.

Bangor & Aroostook.—Located, Brownville to Van Buren, 175 miles, with branches, Eastman to Ft. Fairfield, 12 miles; Dyer Brook to Ashland, 43 miles. Pres., A. A. Burleigh; Ch. Engr., Moses Burpee; both of Houlton.

21. Castine & Bangor Ry. & Navigation Co.—Surveyed, Castine to Milo, 81 miles. Pres., A. M. Devereux, Bangor.

22. George's Valley.—Projected, Warren to Union Common, 8 miles.

23. Kennebec & Franklin.—Projected, Farmington to Gardiner, 40 miles. Pres., John F. Hill, Augusta. Treas., A. M. Spear, Gardiner.

Maine Shore Line.—Surveyed, Hancock to Eastport, with branch to Calais, 112 miles. Ch. Engr., J. N. Green, Bangor.

Total.—Track laid in 1891, 5 miles. In process of construction, 19.95 miles. Surveyed or under survey, 441 miles. Projects of some promise, 48 miles.

### New Hampshire.—Existing Roads.

24. Boston & Maine.—Surveyed, Canaan to Fairlie, Vt., 10 miles.

25. Concord & Montreal.—Track laid in 1891, North Weare to Henniker, 6 miles; at Jefferson, N. H., 2.65 miles. Under construction, Jefferson to Berlin Falls, 17 miles. Surveyed, Goffstown to New Boston, 5.25 miles; Epping to Exeter, 8 miles; Barnstead to Gilmington, 6.5 miles. Under survey, Jefferson Meadows to Waumbek House, 3 miles.

26. Franklin & Tilton.—Track laid in 1891, between Franklin and Tilton, 1 mile.

Projects and Surveys.

27. Moosilauke.—Surveyed, Warren to Moosilauke Mt., 20 miles. Pres., John H. Pearson; Ch. Engr., F. W. Conn; both of Concord.

Total.—Track laid in 1891, 9.65 miles. In process of construction, 22 miles. Surveyed, or under survey, 73 miles.

### Vermont.—Existing Roads.

28. Bristol.—Track laid in 1891, New Haven to Bristol, 6.26 miles.

29. Clarendon & Pittsford.—Surveyed, Proctor to Brandon, 13 miles.

30. Hoosac Tunnel & Wilmington.—Track laid in 1891, Readsboro to Wilmington, 14 miles.

Projects and Surveys.

31. Black River.—Located, Proctorsville to Claremont Junc., N. H., 28.5 miles. Ch. Engr., Geo. A. Ayre, Perkinsville.

Total.—Track laid in 1891, 20.26 miles. Surveyed or under survey, 32 miles. Projects of some promise, 25 miles.

### Massachusetts.—Existing Roads.

32. Boston & Maine.—Located, Stoneham Center to Fells Station, 3 miles.

33. Brookline & Pepperill.—Track laid in 1891, West Groton, north 2 miles. Track laid since Jan. 1, 1892, end of '91 track north, 2 miles. Under construction, end of track to Brookline, N. H., 10 miles. Ch. Engr., F. B. Locke, 53 State St., Boston.

25. Concord & Montreal.—Surveyed, North Acton to Belmont, 16 miles.

34. New York & New England.—Projected, Harvard St. Station to Newton Highlands, 8 miles.

35. Old Colony.—Track laid in 1891, Walpole Junc. to Norwood, 5.76 miles. Surveyed, Norwood to Dedham, 6 miles.

36. Plymouth & Middleboro.—Under construction, Plymouth to Middleboro, 15 miles. Ch. Engr., J. M. Rollins, Jr., Plymouth.

Projects and Surveys.

37. Plymouth & Bournedale.—Surveyed, Plymouth to the Old Conoly R. R., 15.4 miles. Pres., Wm. A. Nye, Bournedale; Ch. Engr., Chas. M. Thompson, Sandwich.

38. Southbridge, Sturbridge & Brookfield.—Surveyed, Brookfield to Southbridge, 13 miles. Ch. Engr., Arthur C. Moore, Sturbridge.

Total.—Track laid in 1891, 7.76 miles. Track laid since Jan. 1, 1892, 2 miles. In process of construction, 20 miles. Surveyed and under survey, 53 miles. Projects of some promise, 8 miles.

### Rhode Island.—Existing Roads.

34. New York & New England.—Surveyed, Pascoag to East Thompson, Conn., 7 miles.

39. Woonsocket & Pascoag.—Track laid in 1891, Nasonville to Harrisville, 4 miles.

Projects and Surveys.

40. Westerly & Jewett City.—Surveyed, Westerly to Jewett City, 28 miles. Pres., Alex. B. Briggs, Ashaway; Ch. Engr., Wm. G. Smith, Waterbury.

Total.—Track laid in 1891, 4 miles. Surveyed and under survey, 17 miles.

New York.—Existing Roads.

40. Westerly & Jewett City.—Surveyed, Westerly to Internaticnal line to Malone, 10 miles; between Malone and Poland, 35 miles. Track laid since Jan. 1, 1892, between Malone and Poland, 25 miles. Under construction, between Malone and Poland, 90 miles.

41. Carthage & Adirondack.—Projected, Little River to Big Tupper Lake, 30 miles.

42. Chateaugay.—Surveyed, Saranac Lake to Lake Placid, 10 miles.

43. Cooperstown & Charlotte Valley.—Surveyed, West Davenport to Davenport Center, 3 miles. Projected, Davenport Center to East Davenport, 4 miles.

Dunderberg, Spiral.—Partly graded at Mt. Dunderberg, 15 miles.

44. Dutchess County.—Track laid in 1891, Poughkeepsie to Hopewell Junc., 12 miles.

45. Elmira, Cortland & Northern.—Surveyed, Camden to Watertown, 60 miles.

46. Kanona & Prattsburg.—Projected, Prattsburg to Geneva, 32 miles.

47. Lake Champlain & Moriah.—Track laid in 1891, Mineville to Fisher Hill, 2 miles.

48. Lehigh Valley.—Track laid in 1891, Buffalo to Geneva, 101.5 miles; East Rush toward Rochester, 8 miles; Van Ettenville north, 5 miles. Track laid since Jan. 1, 1892, 5 miles north of Van Ettenville to Odessa, 14 miles. Under construction, Odessa to Geneva, 38 miles; 8 miles north of East Rush to Rochester, 4 miles.

49. Little Falls & Dolgeville.—Graded, Little Falls to Dolgeville, 12 miles.

50. Long Island.—Under construction, Hempstead to Valley Stream, 6 miles.

51. Rome, Watertown & Ogdensburg.—Surveyed, Buffalo to Suspension Bridge, 25 miles.

52. Ulster & Delaware.—Located, Bloomville to Oneonta, 22 miles.

Projects and Surveys.

53. Middlesex Valley.—Projected, Naples to Stanley, 22 miles. F. B. Merrill, Canandaigua.

54. Oneida, Oneonta & New York.—Surveyed, Oneida to Oneonta, 75 miles. Ch. Engr., W. F. Randall, Oneida.

55. Rome & Carthage.—Projected, Rome to Carthage, 56 miles. Pres., Jas. C. Smith, Rome.

56. Rondout Valley.—Projected, Summitville to Kingston, 40 miles. Pres., Isaac N. Cox, Ellenville.

57. Syracuse & Oneida Lake.—Surveyed, Syracuse to South Bay, 12 miles. Pres., Nelson L. Williams; Ch. Engr., Walter F. Randall, both of Syracuse.

58. Utica & Unadilla Valley.—Surveyed, Bridgewater to New Berlin, 20 miles. Ch. Engr., D. E. Culver, 145 Broadway, New York city.

59. Washington County.—Projected, Greenwich to Rutland, Vt., 56 miles.

Total.—Track laid in 1891, 173.5 miles. Track laid since Jan. 1, 1892, 39 miles. In process of construction, 165 miles. Surveyed or under survey, 227 miles. Projects of some promise, 215 miles.

New Jersey.—Existing Roads.

60. Baltimore & Ohio.—Projected, Pennsville to Cape May, 80 miles.

61. Caldwell.—Track laid in 1891, Great Notch to Caldwell, 4.5 miles.

62. Lehigh & Hudson River.—Track laid in 1891, Hamburg to Franklin, 2 miles. Under construction, Franklin Junc., to zinc mines, 1.7 mile.

48. Lehigh Valley.—Track laid in 1891, Lehigh Valley Terminal, 7.5 miles; Roselle Branch, 1.96 miles; four other branches, 1.72 miles; Lansdown to Pittston, 4 miles.

New York, Susquehanna & Western.—Surveyed, near Hackensack to Lodi, 2 miles.

63. Pennsylvania.—Track laid in 1891, Alloway to Quinton, 4.2 miles.

64. Philadelphia & Reading.—Track laid in 1891, Chew's Landing to Spring Mill, 4.6 miles; Bound Brook toward New York Harbor, 2.8 miles. Partly graded, between Bound Brook and New York harbor, 16.2 miles. Projected, Pleasantville to Woodmansie Station, 35 miles.

65. Philadelphia & Seashore.—Track laid in 1891, Tuckahoe to Sea Isle City, 10 miles.

66. Raritan River.—Partly graded, New Brunswick to Bound Brook, 7 miles.

67. Rockaway Valley.—Track laid in 1891, Peapack to Mendham, 6 miles. Surveyed, Mendham to Morristown, 7 miles. Ch. Engr., J. V. Melick, White House.

Projects and Surveys.

68. Lake Hopatcong, Boonton, Morristown, Caldwell & New York.—Located, Caldwell to Rockaway, 17 miles; branch to Morristown, 7 miles. Sec., H. C. Reynolds, Whippany.

69. Trenton & Atlantic.—Surveyed, Trenton to Point Pleasant, 42.5 miles.

Total.—Track laid in 1891, 49.34 miles. In process of construction, 25 miles. Surveyed and under survey, 76 miles. Projects of some promise, 115 miles.

Delaware.—Existing Roads.

70. Odessa & Middletown.—Partly graded, Odessa to Middletown, 4.5 miles. Ch. Engr., H. B. Campbell, 18 Broadway, New York city.

Projects and Surveys.

71. Laurel & Roaring Point.—Projected, Laurel to Roaring Point, 25 miles.

Total.—In process of construction, 4.5 miles. Projects of some promise, 25 miles.

Maryland.—Existing Roads.

72. Baltimore & Drum Point.—Partly graded, Baltimore to Drum Point, 82 miles. Ch. Eng., Nich. Goldsborough, Baltimore.

60. Baltimore & Ohio.—Track laid since Jan. 1, 1892, Linden to Connecticut Ave., 2 miles. Under construction, between Linden and Fairfax, Va., 23 miles.

73. Confluence & Oakland.—Projected, Manor Land to Confluence, 15 miles. Pres., J. Bayard Henry, 742 Drexel Building, Philadelphia, Pa.

74. Deer Creek & Susquehanna.—Projected, Bell Air to Havre de Grace, 25 miles. Pres., Geo. M. Jewett, Glenville.

75. Gunpowder Valley.—Track laid in 1891, Hoffman to Hoffmanville, 3 miles.

63. Pennsylvania.—Surveyed, Green Springs Junc. to Westminister, 21 miles; Greensboro to Federalsburg, 20 miles.

76. Washington City & Point Lookout.—Projected, Mechanicsville to Point Lookout, 45 miles.

77. West Virginia Central & Pittsburg.—Located, Cumberland to Hagerstown 78 miles. Surveyed, Hagerstown to Baltimore, 75 miles.

Projects and Surveys.

78. Cambridge & Chesapeake.—Projected, Cambridge to Woolford 25 miles. Pres., Jas. Wallace, Cambridge.

79. Washington & Chesapeake.—Surveyed, Washington to Chesapeake Beach, 30 miles. Pres., Henan D. Wallbridge, Washington.

Total.—Track laid in 1891, 3 miles. Track laid since Jan. 1, 1892, 2 miles. In process of construction, 90 miles. Surveyed and under survey, 231 miles. Projects of some promise, 125 miles.

Pennsylvania.—Existing Roads.

80. Altoona & Wansononock.—Track laid in 1891, Logan to Highlands, 7.5 miles; branch, 1.5 miles. Surveyed, Highlands to Frugality, 7 miles. Ch. Engr., W. T. Forsyth, Altoona.

60. Baltimore & Ohio.—Track laid in 1891, branch to Quarries near Milford, 3 miles. Under construction, Uniontown to Quarries, 3 miles. Projected, Fairview, to Middletown, 18 miles.

81. Beech Creek.—Track laid in 1891, Kermoor to Friendship Tunnel, 1 mile. Under construction, between Kermoor and Mahaffey, 15 miles. Ch. Engr., J. B. McIntyre, Jersey Shore.

Beaver & Ellwood.—Under construction, Ellwood City to Coal Lands, 3 miles.

82. Buffalo & Susquehanna.—Under construction, Galeton toward Cherry Springs, 7 miles. Surveyed, mile 7 to Cherry Springs, 5 miles. Pres., F. H. Goodyear, Austin.

83. Buffalo, Rochester & Pittsburg.—Under construction, Howard Junc., to Mt. Jewett, 19 miles. Ch. Engr., J. M. Floesch, Erie.

84. Cammal & English Center.—Under construction, Cammal to English Center, 12 miles.

85.—Clarion River.—Track laid in 1891, Arroyo to Hallton, 6 miles.

86. Coudersport & Port Allegheny.—Surveyed, Sweden Valley to Ansonia, 33 miles.

87. Cumberland Valley.—Surveyed, Ft. Loudon to Mt. Dallas, 46 miles.

88. Delaware River & Lancaster.—Surveyed, Springfield to Lancaster, 33 miles.

89. Delaware, Susquehanna & Schuylkill.—Track laid in 1891, Drifton to Oneida, with branches, 39 miles.

90. Eagle's Mere.—Under construction, Sonestown to Eagle's Mere, 6 miles. Pres., A. J. Maloney, Philadelphia.

91. Elk Hill Coal & Iron.—Track laid in 1891, near Scranton to Dickson City, 1.5 miles.

92. Emporium & Rich Valley.—Track laid in 1891, Emporium to Big Run, 8 miles. Under construction, Big Run to county line, 2.5 miles. Ch. Engr., E. H. Welch, Emporium.

93. Erie & Wyoming Valley.—Surveyed, Hoadley's to Honesdale, 5 miles.

94.—Gettysburg & Chambersburg.—Track laid in 1891, Conocoheague to Wolf Hill, 10 miles.

95. Glen Hazel & Shawmut.—Track laid in 1891, Glen Hazel to Beardsley, 6 miles. Surveyed, Beardsley to Rockport, 24 miles.

96. Hunter's Run & Slate Belt.—Under construction, Pine Grove Furnace to slate Quarries, 5.5 miles. Pres., J. C. Fuller, Pine Grove. Ch. Engr., A. E. Lehman, 711 Walnut St., Philadelphia.

97. Ketner, Elbon & Shawmut.—Surveyed, between Ketner and Shawmut, 28 miles. Pres., R. F. Cartwright; Ch. Eng., Alfred Herdman, both of Ridgeway.

98. Kinzua Hemlock.—Track laid in 1891, Camp Halsey to West Line, 9 miles. Pine Run branch, 1.5 miles.

99. Kinzua Valley.—Track laid in 1891, Morrison's to West Line, 14 miles.

100. Lackawanna & Montrose.—Track laid in 1891, Montrose to Montrose Station, 10.5 miles.

101. Lancaster, Oxford & Southern.—Surveyed, Quarryville to White Rock, 9 miles; Oxford to Singerly, Md., 14 miles. Ch. Engr., S. C. Slaymaker, Lancaster.

48. Lehigh Valley.—Track laid in 1891, West End extension at Allentown, 0.14 miles; West Side connecting at Wilkes Barre, 4.37 miles; Thorndale branch, 5.77 miles; Loyalsock branch, 1.55 miles. Projected, Lopez to Nordmont, 4 miles; Berwick to White Haven, 25 miles.

102. Mahoning Valley.—Track laid in 1891, Stanley to Helvetia, 2 miles. Surveyed, Helvetia to Rockton, 9 miles. Ch. Engr., Walter F. Armes, Stanley.

103. Newport & Sherman's Valley.—Track laid in 1891, Elliotsburg to Blaine, 13 miles.

63. Pennsylvania.—Track laid in 1891, Glen Loch to Morrisville, 45 miles; Cochran Station to McKeesport, 1.47 miles; Stewart to Murrayville, 6.5 miles; South Fork Station to Dunlo, 7.93 miles; Pencoyd branch, 1.28 miles; extensions of Clearfield branches, 8.23 miles; Turtle Creek branch, 2.02 miles; West Penn. R. R. branches, 9.45 miles; Marginal R. R., Beaver Falls, 2.96 miles; miscellaneous extensions, 2.33 miles. Track laid since Jan. 1, 1892, Kaylor to Brubaker, 20 miles. Under construction, Chestnut Hill Branch to Ft. Washington, 6 miles; Plattsville to Minersville, 7 miles; Fairchance to Morgantown, W. Va., 19 miles; Mann's Choice to Brook's Mills, 50 miles; Trenton Cut-off to Swedeland Furnace, 1.5 miles. Surveyed, Murrayville to Belmont, 6 miles; Germantown to the Trenton Cut-off, 10 miles; Tombicken to New Boston, 23 miles; Fort Washington to Doylestown, 15 miles. Projected, Bustleton to the Trenton Cut-off, 8 miles.

104. Perry County.—Track laid in 1891, New Bloomfield to Nelsons, 4 miles; graded, Nelsons to Landesville, 7 miles. Projected, Landesville, to Newville, 13 miles. Ch. Engr., Jas. Elliott, New Bloomfield.

64. Philadelphia & Reading.—Track laid in 1891, Bowmansdale to Harrisburg, 8.76 miles; Mt. Carmel to Natalie, 6 miles; Lofty to the Delaware, Susquahanna & Schuylkill R. R., 10 miles. Under construction, terminal line at Philadelphia, 4 miles. Located, Tower City to Brookside, 1.5 miles. Surveyed Chestnut Hill to Glenside, 4 miles. Projected, Tabor branch to Philadelphia & Newton R. R., 1.25 miles.

Pittsburg & Lake Erie.—Under construction, branch up Monogahela River, 5 miles.

105. Pittsburg & Moon River.—Track laid in 1891, Groveton to Moon River, 5 miles.

106. Pittsburg, Shenango & Lake Erie.—Track laid in 1891, Dixonburg to Wallace Junc., 24.7 miles; Erie Junc. to Erie, 2.5 miles; Cranesville to Erie & Pittsburg Junc., 2 miles. Graded, Erie & Pittsburg Junc. to Conneaut, O., 10 miles. Ch. Engr., F. P. James, Greenville.

107. Sugar Run.—Under construction, Sugar Run Junc. to Sugar Run Station, 12 miles. Pres., W. B. Lewis, Coudersport. Ch. Engr., F. W. Dalrymple, Bradford.

108. Susquehanna.—Track laid in 1891, at Costello, 1 mile. Graded, between Costello and Hulls, 13 miles. Pres., F. H. Goodyear; Ch. Engr., C. E. Botsford, both of Austin.

109. Western Maryland.—Surveyed, Porter's Station to York, 15 miles; Thomasville to Bowmansdale, 20 miles.

110. Western New York & Pennsylvania.—Located, New Castle to Oil City, 43 miles.

111. Wilkes Barre & Western.—Track laid in 1891, Rohrsburg to Orangeville, 3 miles. Surveyed, Orangeville to Wapwollopen, 13 miles.

Projects and Surveys.

112. Altoona Short Line.—Projected, Everett to Ore Hill, 40 miles. James Dennithorn, Huntington.

113. Coudersport & Wellsboro.—Projected, Galeton to Ansonia, 13 miles. L. H. Goodyear, Austin.

114. Forest Central.—Surveyed, Tionesta to Kellettsville, 15 miles. Pres., F. F. Whitteken, Tionesta.

115. New York, Philadelphia & Chicago.—Surveyed, Franklin to Clearfield, 90 miles. Ch. Engr., Geo. C. Hamilton, Franklin.

116. Pennsylvania, Lehigh & Eastern.—Surveyed, Port Jervis, N. Y. to Tomhicken, 100 miles. Pres., Joseph Poole, 111 Broadway, New York City.

117. Pennsylvania Midland.—Surveyed, Stroudsburg to Scranton, 55 miles. Pres., John Jermayn, Scranton.

118. Pittsburg, Cannonsburg & State Line.—Surveyed, Pittsburg to Wheeling, W. Va. Pres., A. C. Succop, Pittsburg.

119. Reading, Lancaster & Baltimore.—Projected, Reading to Perryville, Md., 75 miles. Pres., H. C. Lehman; Ch. Engr., S. C. Slaymaker, both of Lancaster.

120. Southern Central.—Projected, Sunbury to Dauphin, 45 miles. Pres., C. W. McKeehan, Philadelphia, Pa.

121. Wilkes Barre & Eastern.—Under survey, Wilkes Barre to Stroudsburg, 60 miles. Pres., W. P. Ryman; Ch. Engr., I. E. Hartwell; both of Wilkes Barre.

Total.—Track laid in 1891, 299.55 miles. Track laid since Jan. 1, 1892, 20 miles. In process of construction, 203 miles. Surveyed and under survey, 767 miles. Projects of some promise, 237 miles.

Ohio.—Existing Roads.

60. Baltimore & Ohio.—Track laid in 1891, between Akron and Chicago Junc., 46 miles.

122. Cleveland & Canton.—Projected, Sherodsville to Portland, 35 miles.

Cleveland Belt.—Partly graded, belt line at Cleveland, 7 miles. Ch. Engr., H. A. Kennedy, Cleveland.

123. Cleveland, Wooster & Western.—Track laid in 1891, Wooster to Lodi, 20 miles.

124. Delaware & Eastern.—Partly graded. Delaware to Centerburg, 22 miles. David Paul, Centerburg.

Findlay Belt.—Graded, belt line at Findlay, O., 10 miles.

125. Findlay, Ft. Wayne & Western.—Track laid in 1891, Glandorf to Miami & Erie Canal, 14.25 miles. Under construction, Miami & Erie Canal to Fort Wayne, Ind., 41 miles. Projected, Findlay to Greenwich, 60 miles. Ch. Engr., B. W. Fenton, Findlay.

126. Lake Erie, Alliance & Southern.—Projected, Bergholz to Steubenville, 15 miles.

127. Lancaster & Hamden.—Partly graded, Laurelville to Wellston, 37 miles. Surveyed, C. & M. V. Junc. to Columbus, 30 miles; Tarlton to Lancaster, 17 miles.

128. Middletown & Cincinnati.—Track laid in 1891, point south of Middletown to King's Station, 12 miles.

129. Norfolk & Western.—Track laid in 1891, Coal Grove to Ohio River, 7.8 miles.

130. Pittsburg, Akron & Western.—Track laid in 1891, between Akron and Cary, 16 miles. Projected, Akron to New Castle, Pa., 70 miles.

131. Pittsburg, Ohio Valley & Cincinnati.—Track laid in 1891, Bellaire toward Powhatan, 7 miles. Track laid since Jan. 1, 1892, end of 1891 track to Powhatan, 8 miles. Surveyed, Powhatan to Marietta, 60 miles.

132. Port Clinton Short Line.—Surveyed, Port Clinton to Fremont, 20 miles. Pres., E. H. Brennan, Port Clinton.

133. Salem & Washingtonville.—Under construction, Salem to Washingtonville, 7 miles.

134. Sandusky & Columbus Short Line.—Track laid in 1891, Sandusky to Bellevue, 12.5 miles. Under construction, Bellevue to Columbus, 93 miles. Pres., John McKelvey, Sandusky. Ch. Engr., F. J. Ald, Marion.

135. Toledo, Columbus & Cincinnati.—Track laid in 1891, Kenton to Ridgeway, 9 miles. Surveyed, Ridgeway to Columbus, 50.8 miles. Ch. Engr., J. C. Williams, Kenton.

136. Toledo, Walhonding Valley & Ohio.—Under construction, Loudonville to Coshocton, 46 miles. Sur-

veyed, Coshocton to Kimbalton, 22 miles. Ch. Engr., J. A. Hanlon, Coshocton.

137. Wheeling & Lake Erie.—Surveyed, Rush Run to Smithfield, 8 miles.

Zanesville Terminal.—Track laid in 1891, in the vicinity of Zanesville, 3.8 miles.

Projects and Surveys.

138. Columbus & Westerville.—Surveyed, Columbus to Westerville, 12 miles. Pres., Moses H. Nell; Sec., G. W. Meeker; both of Columbus.

139. Columbus, Lima & Milwaukee.—Surveyed, Columbus to Defiance, 125 miles.

140. Eastern Central.—Projected, Bucyrus to Bowerstown, 100 miles. Ch. Engr., E. B. Shipley, Bucyrus.

Total.—Track laid in 1891, 48.35 miles. Track laid since Jan. 1, 1892, 8 miles. In process of construction, 262 miles. Surveyed and under survey, 345 miles. Projects of some promise, 270 miles.

Indiana.—Existing Roads.

141. Chicago & Southeastern.—Track laid in 1891, Sand Creek to Bridgeton, 10 miles; Carbon to Brazil, 5 miles. Partly graded, Bridgeton to Carbon, 5 miles. Surveyed, Sand Creek to Waveland, 10 miles.

142. Cleveland, Cincinnati, Chicago & St. Louis.—Located, Harrison to Richmond, 39 miles. Projected, Louisville, Ky., to Aurora, 100 miles.

143. Ft. Wayne, Terre Haute & Southwestern.—Track laid in 1891, Carbon to Mansfield, 10.5 miles.

144. Indiana, Illinois & St. Louis.—Projected, Knox to Lincoln, 40 miles.

Louisville, Evansville & St. Louis.—Track laid in 1891, at city of Princeton, 2.5 miles.

Ohio & Mississippi.—Track laid in 1891, branch to quarries, 1.42 miles.

145. Wabash.—Under construction, Montpelier, O., to Hammond, 165 miles.

Projects and Surveys.

146. Chicago, Indianapolis & Chattanooga Southern.—Located, Rockport to Mitchell, 82 miles. Projected, Mitchell to Indianapolis, 90 miles. Pres., D. P. Irwin, Indianapolis. Ch. Engr., J. H. McCormick, Columbus.

147. Chicago, Union City & Cincinnati.—Surveyed, Union City to Bluffton, 60 miles. Pres., J. C. Fawcett; Ch. Engr., J. Frank White; both of Louisville.

148. Indianapolis, Logansport & Chicago.—Surveyed, Indianapolis to Logansport, 68 miles. Pres., E. N. Talbott; Ch. Engr., Walter A. Osmer; both of Logansport.

Total.—Track laid in 1891, 29.4 miles. In process of construction, 173 miles. Surveyed and under survey, 259 miles. Projects of some promise, 230 miles.

Michigan.—Existing Roads.

149. Chicago & West Michigan.—Track laid in 1891, Traverse City to Spencer Creek, 25 miles; Charlevoix toward Petoskey, 16 miles; Williamsburg to Elk Rapids, 8 miles. Track laid since Jan. 1, 1892, end of 1891, track to Petoskey, 2 miles; Spencer Creek to near Central Lake, 17.2 miles. Under construction, near Central Lake to Charlevoix, 18.8 miles; Charlevoix to Ironton, 4.5 miles.

150. Chicago, Kalamazoo & Saginaw.—Surveyed, Woodbury to St. Johns, 31 miles. Projected, St. Johns to Saginaw, 40 miles.

Duluth, South Shore & Atlantic.—Surveyed, Negaunee to North Escanaba, 55 miles.

151. Flint & Pere Marquette.—Track laid in 1891, Redford Junc., toward Delray, 8.5 miles. Under construction, Michigan Central Ry. to Delray, 2.5 miles.

Frost.—Graded, Kenton to Withy, 7.12 miles. Supt. Cons., S. Dumond, Kenton.

152. Grand Rapids & Indiana.—Under construction, Clarion to Bear Lake, 1.07 miles. Surveyed, Bear Lake to Boyne City, 5 miles. Projected, Ludington to Vincent, 33 miles. Ch. Engr., G. S. Johnson, Grand Rapids.

153. Grand River.—Partly graded, Grand Rapids to Grand Haven, 36 miles. Pres., J. W. Boynton, Grand Rapids.

Iron Range & Huron.—Graded, Huron Bay to Champion, 60 miles. Ch. Engr., Milo Davis, Detriot.

154. Manistee & Grand Rapids.—Track laid in 1891, Sauble River toward Luthur, 12.63 miles. Under construction, end of track to Luthur, 9.5 miles. Surveyed, Luthur to Grand Rapids, 67 miles. Ch. Engr., E. W. Muenscher, Manistee.

155. Manistee & Northeastern.—Track laid in 1891, Lake Ann to Cedar River, 5.48 miles. Partly graded, Cedar River to Traverse City, 14.5 miles.

Milwaukee, Lake Shore & Western.—Track laid in 1891, Little Falls northwest, 9.29 miles; branch south, 3.47 miles. Under construction, 9.29 miles west of Little Falls, northwest, 4.32 miles.

156. St. Joseph Valley.—Graded, Berrien Springs to Hinchman, 6 miles. Surveyed, Hinchman to Benton Harbor, 10 miles.

Projects and Surveys.

157. Crystal Lake.—Projected, Toledo, Saginaw & Mackinaw R. R. to Crystal Lake, 7 miles.

Manistique & Negaunee.—Surveyed, Negaunee to Manistique, 91 miles. H. David, Manistique.

Total.—Track laid in 1891, 87.37 miles. Track laid since Jan. 1, 1892, 19.2 miles. In process of construction, 160 miles. Surveyed or under survey, 250 miles. Projects of some promise, 80 miles.

Virginia.—Existing Roads.

Abingdon Coal & Iron.—Under construction, Abingdon to Damascus, 15 miles. Ch. Engr., J. C. Watson, Jr., Abingdon.

60. Baltimore & Ohio.—Surveyed, Lexington to Roanoke, 50 miles.

Bristol Belt.—Track laid in 1891, at Bristol, Tenn., 5 miles.

158. Chesapeake & Ohio.—Track laid in 1891, Bessemer to Craig City, 26.5 miles; Covington to Hot Springs, 25 miles. Under contract, New River Branch, 4 miles; Keeney Creek branch, 5 miles.

Danville & East Tennessee.—Surveyed, Danville to Bristol, 175 miles. Ch. Engr., T. W. M. Draper, 45 Broadway, New York City.

159. Farmville & Powhatan.—Under survey, branch to Manchester, 15 miles.

Glasgow Belt.—Track laid in 1891, at Glasgow, 1.5 miles.

Louisville & Nashville.—Track laid in 1891, between Cumberland Gap and Norton, 38 miles.

Lynchburg Belt.—Under contract, at Lynchburg, 2.25 miles.

129. Norfolk & Western.—Track laid in 1891, extension to Norton, 8.7 miles; Roanoke Belt Line, 1.8 miles. Partly graded, Great Outburst to North Carolina line, 20 miles. Under construction, at Roanoke, 6.75 miles; at Christiansburg, 3 miles. Under contract, Coeburn to Coal Fields, 2 miles. Surveyed, Front Royal to Washington, 70 miles; branch up Russell Creek, 2 miles.

160. Orange & Keysville.—Surveyed, Keysville to Arvonia, 50 miles. Ch. Engr., W. A. Dafter, Farmville.

161. Roanoke & Southern.—Track laid in 1891, North Carolina line to Roanoke, 75.7 miles.

162. Roanoke, Fincastle & Clifton Forge.—Under construction, Fincastle to Cloverdale, 12 miles. Projected, Roanoke to Clifton Forge, 35 miles. Pres., Chas. H. Vines, Fincastle; Ch. Engr., Jas. K. Brown, Roanoke.

Projects and Surveys.

163. Augusta, Highland & Allegheny.—Projected, Staunton to Monterey, 46 miles. Pres., W. D. Rippetoe, Buffalo Gap.

164. Blacksburg.—Projected, Blacksburg to Roanoke, 32 miles. Pres., J. F. Christian, Roanoke.

Bristol & Northern.—Projected, Bristol to Cleveland, 35 miles. Ch. Engr., Geo. S. Bruce, Bristol.

Marion & Rye Valley.—Projected, Marion up Rye Valley, 56 miles. Seven miles surveyed to be built in 1892. Pres., P. S. Swaine, New York City. Ch. Engr., W. C. Foster, 52 Broadway, New York City.

Total.—Track laid in 1891, 162.2 miles. In process of construction, 80 miles. Surveyed or under survey, 369 miles. Projects of some promise, 185 miles.

West Virginia.—Existing Roads.

60. Baltimore & Ohio.—Under construction, Morgantown to Uniontown, Pa., 29 miles.

1650. Charleston, Clendennin & Sutton.—Under contract, Charleston northeast, 20 miles. Surveyed, 20 miles, to Sutton, 80 miles. Pres. F. W. Abney; Secy., J. B. Floyd; Ch. Engr., C. K. McDermont, Charleston.

158. Chesapeake & Ohio.—Under construction, Rush Run branch, 3.75 miles. Kings Creek branch, 5 miles.

166. Huntington & Big Sandy.—Track laid in 1891, Huntington to Twelve Pole River, 6 miles. Under construction, Twelve Pole River to Kenova, 4 miles.

167. Kanawha & Michigan.—Surveyed, Malden to Kanawha Falls, 35 miles.

129. Norfolk & Western.—Ohio Extensions.—Track laid in 1891, Kenova to Boisevain, 48.2 miles; Elkhorn to Hallsville, 21.5 miles. Under construction, Boisevain to Hallsville, 113.5 miles. Track laid in 1891., Mine Bank branch, 2.9 miles; Russel Creek branch, 1.3 miles.

168. Ohio River.—Track laid in 1891, New Erie to Spencer, 25 miles. Under construction, extension to Huntington, 8 miles. Projected, Spencer to Burnesville, 40 miles.

169. Snowey Creek & Cranesville.—Track laid in 1891, Snowey Creek to Cranesville, 10 miles.

109. Western Maryland.—Graded, Williamsport, Md., to Cherry Run, 14.3 miles.

77. West Virginia & Pittsburg.—Track laid in 1891, Burnesville to Sutton, 18.4 miles; Alton to Newton, 7 miles; Gauley Junc. to Elk River, 8 miles. Partly graded, Newton to Pickens, 10 miles; Elk River to Gauley River, 32 miles.

170. West Virginia Central & Pittsburg.—Track laid in 1891, Junction to Beverly, 5.5 miles. Elkins to Bealington, 17.5 miles.

Wheeling Bridge & Terminal.—Tract laid in 1891, at Wheeling, 5.5 miles.

Projects and Surveys.

171. Bayard, Petersburg & Moorefield.—Surveyed, Bayard to Moorefield, 40 miles. Pres., J. G. Hoffman, Jr., Wheeling.

172. Bluefield & Princeton.—Surveyed, Bluefield to Princeton, 10 miles. Ch. Engr., H. S. Lamble, Roanoke.

173. Greenbrier & Gauley.—Projected, Alderson to the Gauley River, 45 miles. Pres., Alex. McVeigh Miller; Ch. Engr., Wm. P. Smith; both of Alderson.

174. Hinton & New River.—Under survey, Hinton to the mouth of East River, 33 miles. Pres., J. H. Miller, Hinton.

Parkersburg Belt.—Projected, belt line at Parkersburg, 7 miles.

175. Powellton & Pocahontas.—Projected, Powellton to Pocahontas, 60 miles. Pres., Evan Powell; Ch. Engr., M. W. Venable; both of Powellton.

176. St. Albans & Coal River.—Surveyed, St. Albans to Madison, 42 miles. Ch. Engr., W. C. Reynolds, 232 Broad St., Charleston.

177. Wheeling & Connellsville.—Under survey, Wheeling to Connellsville, Pa., 60 miles. Pres., W. A. Lynch, Canton, O. Ch. Engr., 150 Broadway, New York City.

Total.—Track laid in 1891, 176.8 miles. In process of construction, 242 miles. Surveyed and under survey, 273 miles. Projects of some promise, 152 miles.

Kentucky.—Existing Roads.

178. Cincinnati & Kentucky Southern.—Surveyed, Yosemite to Danville, 16 miles. H. D. Emerson, Cincinnati, O.

179. Kentucky Midland.—Surveyed, Paris to Morgan Co., line, 75 miles.

180. Kentucky Union.—Track laid in 1891, Katowa to Inverness, 3 miles.

Middlesborough Belt.—Track laid in 1891, branch up Stony Fork near Middlesborough, 3.96 miles.

181. Ohio & Big Sandy.—Track laid in 1891, Richardson toward Big Sandy Bridge, 14 miles. Track laid since Jan. 1, 1892, 14 miles. Big Sandy Bridge, 2 miles.

Ohio Valley.—Under construction, Gracey to Hopkinsville, 10 miles.

182. Owensboro, Falls of Rough & Green River.—Under survey, Fordsville to Caneyville, 20 miles.

183. Richmond, Nicholasville, Irvine & Beattyville.—Track laid in 1891, Richmond to Irvine, 22 miles. Partly graded, Irvine to Beattyville, 35 miles.

Projects and Surveys.

184. Bowling Green & Northern.—Surveyed, Grayson's Springs to Scottville, 75 miles. Pres., J. Proctor, Knott's, Lebanon.

185. Chicago, Evansville & Chattanooga.—Under contract, Evansville, Ind., to Bowling Green, 100 miles. Pres., S. K. Sneed, Henderson. Ch. Eng., A. B. Fitch, Terre Haute, Ind.

186. Fordsville, Hartford & Southwestern.—Projected, Fordsville to Hartford, 24 miles. Pres., Thos. J. Smith; Ch. Eng., John J. McHenry; both of Hartford.

Total.—Track laid in 1891, 42.96 miles. Track laid since Jan. 1, 1892, 2 miles. In process of construction, 145 miles. Surveyed and under survey, 186 miles. Projects of some promise, 24 miles.

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Car heating by exhaust steam from the locomotive is the subject of an English patent by Lieutenant Graydon, and the International Railway Carriage Heating Co. has been organized to introduce this system.

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A bridge across the Harlem Ship Canal at Kingsbridge Road is provided for by an appropriation of $400,000 by the New York Legislature. Work will probably be commenced at once so as to put in the foundation before the water is let into the canal.

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The Poughkeepsie Bridge Co. has been reorganized and the terms are now made known. The bridge company and the Central, New England & Western Ry. are now parts of the Reading system, and the two corporations are merged. The Reading guarantees the principal and interest on $7,250,000 first mortgage bonds, for which $3,750,000 will be issued for 75 per cent. of the bridge company's bonds; $2,500,000 for a like proportion of the railway's first mortgage bonds and $1,000,000 is to be retained in the treasury for improvements. These bonds will bear 4 and 5 per cent. interest. In exchange for the general mortgage bonds of the railroad, $1,750,000 5 per cent. income mortgage bonds will be issued, and $2,100,000 of the same class of securities will be used in taking up the remaining 25 per cent. of the bridge company's bonds, and the scrip issued for defaulted interest. Ten per cent. will be given to holders of the railroad first mortgage bonds as compensation for the reduction in their interest. Security holders have until April 30 in which to surrender their holdings.

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The Boston Rapid Transit Commission has sent a report to the Massachusetts Legislature. It recommends that a Metropolitan Transit Commission be created to prepare preliminary work and street changes for rapid transit; that a ten-year franchise be granted to the West End Ry.; that dividends on West End common stock be limited to 8 per cent., all above that to be divided with the city; that the Old Colony R. R. surrender the Providence station to the Boston & Albany, and that the New York & New England abandon its present passenger terminus in Boston and unite its surburban service with the Old Colony, both terminating in a consolidated terminal in the place of the present Old Colony and Boston & Albany stations. It also recommends that the city and state unite in this work. The Commission recommends a circuit elevated road, uniting all depots and radial lines of surface roads, on lines already given in this journal, and aggregating 13 1-2 miles in length. The report contains a constitutional amendment to give the right of eminent domain over property. The report says that if the elevated road, which is necessary, and the street widenings are to be considered as one enterprise and the streets are to be opened under the present law, the cost is estimated at $16,000,000 or $17,000,000. If the constitutional amendment giving right of eminent domain could be adopted the cost would be from $13,000,000 to $14,000,000. The cost of construction is figured at $9,000,000, and the equipment $1,000,000, which is included in the total given. Commissioner Richardson dissents from the report. He wishes the circuit road to go around Beacon Hill instead of under Tremont St. He recommends, in a minority report, the plan of President Whitney, of the West End road, for an elevated structure through Harrison Ave., Hawley St. and Post-office Square to Charlestown, etc. The commissioners point out that while the Boston Metropolitan district now holds 850,000 people, 50 year ago it had a population of only 170,000, and 100 years agno 30,000. In the year ending Sept. 30, 100 years ago 30,000. In the year ending Sept. 30, ton 17,000,000 passengers; in 1881 this figure was 25,000,000, and in the last year the volume had swollen to 51,000,000. The street railways carried 34,000,00 passengers in 1871; 68,000,000 in 1881, and 136,000,000 in 1891, the traffic doubling in each decade.

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A complete block signal system for the New York Bridge, has now been contracted for. It is expected to

have the work complete to Albany by Aug. 15, and to Central between New York and Buffalo and Suspension Buffalo, Nov. 1. On the Albany-Buffalo section, 297 miles, there will be 93 blocks, 73 of them on overhead bridges spanning four tracks. Up to Poughkeepsie, as heretofore announced, and illustrated in these columns, the work was let to the Johnson Railway Signal Co. Thence to Albany the work was let some time ago to the Union Switch & Signal Co., which now appears to have secured the contract from Albany westward also. The entire plant is to be of the Sykes type, and it is announced that the absolute block will be used for both passenger and freight trains, except that at each end of divisions and of very large yards, auxiliary automatic electric signals will be placed on each freight track between the regular block stations, and these portions of the freight tracks only will be worked permissively. If these signals are of the track circuit type, however, they also will be in effect absolute block signals. The Harlem R. R. is to be similarly equipped up to White Plains. This equipment, when completed, will be far and away the best in America, if not in the world, and the Central deserves great honor for adopting it. The cost is vaguely stated at "several hundreds of thousands," but the return will be much greater.

## CONSTRUCTION NEWS.

### RAILWAYS.

#### East of Chicago.—Existing Roads.

CLEVELAND & CANTON.—It is stated that construction has been begun on the proposed extension from Justus to Dalton, O., 10 miles.

PHILADELPHIA & READING.—This company will soon begin surveys for a branch from Exton to West Chester, Pa., about 6 miles. It is stated that a charter will be secured at once, and the line constructed this season.

RARITAN RIVER.—This company has abandoned its charter for building a railway from New Brunswick to Bound Brook, N. J., about 7 miles.

EAGLE'S MERE.—Work has begun on this 6-mile railway in Sullivan Co., Pa., This line will be narrow gage and it is to be completed by July 1.

PENNSYLVANIA.—About $7,000,000 will be expended this year and next on the Pennsylvania lines west of Pittsburg, with a view to accommodating the World's Fair traffic. About $5,000,000 will be equally divided between the Pittsburg, Ft. Wayne & Chicago R. R., and the Pittsburg, Chicago, Cincinnati & St. Louis R. R., in laying several hundred miles of new double track, for which work the contracts have been awarded. The remaining $2,000,000 will be devoted to new locomotives, passenger coaches and other rolling stock. A new system for the entrance tracks in Chicago will be adopted, and extensive additions will be made to the station facilities at Englewood, Archer Ave., and other points in Chicago. The improvements on the Pan Handle line will also make it practically a double track road. In laying the new tracks on both roads steel rails, weighing 85 lbs. per yard, will be used.

#### Projects and Surveys.

READING, LANCASTER & BALTIMORE.—Surveys for this proposed railway from Reading, Pa., to Perryville, Md., 75 miles, have been begun. Ch. Engr., S. C. Slaymaker, Lancaster, Pa.

MARYLAND.—Bills have been introduced in the legislature authorizing Talbot Co. to subscribe for $15,000 of the stock of the Easton, Trappe & Cambridge R. R. Co., amending the company's charter, and changing an appropriation of $58,000 in aid of the Elkton & Sassafras R. R. to the Easton & Northern R. R. Co., which proposes building a railroad from Easton to Singerly.—A bill has also been introduced in the legislature amending the charter of the Columbia & Maryland R. R. Co., and providing for a railroad from Washington, D. C., to Laurel, and thence to the Pennsylvania line, with branches.

HUDSON RIVER R. R. & TERMINAL CO.—This company has been chartered in New Jersey to build and operate a railway from Little Ferry to Edgewater, Bergen Co., N. J. Among the incorporators are T. C. Provost, Caldwell, N. J., and M. J. DeWitt, Newark, N. J.

TIONESTA VALLEY & HICKON.—Chartered in Pennsylvania to build a railway from Nebraska, Pa., to Ross Run, Forest Co., Pa. Pres., Truman D. Collins, Nebraska, Pa.

NEW YORK & BOSTON.—Chartered in New York to build a railway from the town of Rye, Westchester Co., to some point on the shore of Long Island Sound, in the town of Westchester, a distance of about 20 miles. Among the incorporators are Edward V. Cary, Montclair, N. J., and Medad E. Stone, New Brighton, N. Y.

BUFFALO & HAMBURG.—Chartered in New York to build a railway from Buffalo to Hamburg, N. Y. Among the incorporators are Lewis M. Wheelock, Hamburg, N. Y.; Milton E. Beebe, Fredonia, N. Y., and Benj. J. Hamilton, Buffalo, N. Y. The principal offices will be at Hamburg, N. Y.

INDIANAPOLIS, LOGANSPORT & CHICAGO.—The survey for this railway between Logansport and Indianapolis, Ind., 68 miles, has been practically completed. The projectors state that the money necessary to construct the road is in readiness, and that there is no doubt of it being built.

#### Southern.—Existing Roads.

TENNESSEE & COOSA.—The contract for building the short stretch of road necessary to bring this line into Guntersville, Ala., has been let to A. N. Nichols. Work is to begin at once.

NORFOLK & WESTERN.—The contract for building the Russell Creek branch, from Virginia City, Va., to the Clinch Valley Coal & Coke Co.'s mines, 3 miles, has been awarded to Vaughen & Suck.

SAVANNAH, AMERICUS & MONTGOMERY.—It is stated that this company now has a full corps of surveyors at work on its proposed extension from Lyons to Savannah, Ga.

TENNESSEE MIDLAND.—A press dispatch from Richmond, Va., says: "At a general meeting of the stockholders of the Virginia Construction Co., held April 1, the agreement made by the Board of Directors March 1, for the disposition of its interests in the securities of the Tennessee Midland R. R. Co. was ratified by the affirmative vote of the holders of about three-quarters of all the stock of the company. This company, of which Col. A. S. Buford is President, built the Tennessee Midland R. R. from Memphis to Perryville, Tenn., about 136 miles, and held nearly the entire issue of its securities. The price paid is understood to be $2,350,000, of which $530,000 is cash and the residue is guaranteed 5 per cent. bonds. The purchaser is Mr. T. J. Moss, of St. Louis, Mo., who is the principal owner of the Paducah, Tennessee & Alabama R. R., now in operation from Paducah, Ky., to Hollow Rock, Tenn., under construction to a junction with the Tennessee Midland, and projected to Sheffield, Ala., where connection will be secured for Birmingham, Ala., forming a through line from St. Louis to Birmingham, with connections via the Tennessee Midland to Memphis and Nashville."

#### Projects and Surveys.

MEXICAN GULF, PACIFIC & PUGET SOUND.—The name of this company has been changed to the Pensacola & Northwestern R. R. Co. It proposes to build a railway from Pensacola, Fla., to Memphis, Tenn., and a considerable amount of surveying has been done according to reports. There is not much likelihood of the line being built.

WINSTON & BONE VALLEY.—Chartered in Florida to build a railway from Winston, Fla., to the mouth of the Menatee River, about 60 miles.

#### Northwest.—Existing Roads.

BURLINGTON & MISSOURI RIVER.—Rumors are in circulation that this company will soon build its proposed extension from Edgemont, S. Dak., to Longmont, Colo., about 400 miles.

DULUTH, MISSISSIPPI RIVER & NORTHERN.—Foley Bros. & Grant, of St. Paul, Minn., have the contract for building 15 miles of this railway, and work will begin at once. The line, when completed, will be about 30 miles long, and is being built to develop large tracts of timber. Wells, Stone & Co., of Saginaw, Mich., are interested in the enterprise, and W. A. Dafter, of Swan River, Minn., is Ch. Engr.

#### Projects and Surveys.

IOWA.—A press dispatch says: "A new railway company is about to be incorporated here by Hamilton Brown, backed by Eastern capital. It will be built from Fort Dodge to Pocahontas Center, the only county seat in Iowa without a railway, and thence on an indefinite route. The stock is all taken, and the road will certainly be built this season."

#### Southwest.—Existing Roads.

KANSAS CITY, WATKINS & GULF.—This company has recorded a mortgage to the Central Trust Co., of New York City, for $20,000,000. The city of Alexandria, La., has voted to extend the time for the completion of this line for 60 days, to donate the company 25 acres of land for terminal facilities and a five mill tax on all city assessed property.

EASTERN LOUISIANA.—About 150 men are now at work on a branch of this railway to Mandeville, La. It is expected to have the line completed in a few months.

#### Projects and Surveys.

VELASCO NORTHERN.—J. H. Berard, Velasco, Tex., writes us that this proposed railway from Velasco to Rosenburg Junc., Tex., will be 60 miles long. The route is through a level country, affording light grades and curves. Surveys are now in progress.

#### Rocky Mt. and Pacific.—Existing Roads.

UNION PACIFIC.—Surveys are in progress for a branch from Victor Junc., Colo., to Acme Coal Co's. mine, about 7 miles. The line is to be completed by July 1.

GREAT SALT LAKE AND HOT SPRINGS.—We are indebted to Mr. J. F. Woodman, V.-P., for the following information: "This company, which was incorporated in October, 1891, already has about 15 miles of track in operation, and about 24 miles of extensions in contemplation for the next year. The road is used for passenger and freight traffic, and operates between Salt Lake City, Hot Springs and Farmington, Utah. The extension to the new town of Woodman has been decided upon, and the other line proposed is around the mountain to the coal mines near Devil's Gate. The officers are S. Van Berger, Pres., J. F. Woodman, V.-P., J. M. McCartney, Gen. Man., all of Salt Lake City.

#### Projects and Surveys.

ALBUQUERQUE & DURANGO.—In a recent interview Geo. L. Brooks, of Albuquerque, N. Mex., one of the directors, is reported as saying that this railway will run from Albuquerque to Durango, Colo., 210 miles. The organization of the company has been completed and negotiations are now in progress to place the bonds in New York City.

#### Foreign.

BRAZIL.—A press dispatch says: "The Bureau of the American Republics is informed of the successful completion of the Grand Trunk Ry. of Uruguay from Montevideo 352 miles almost due north to the Town of Rivera, on the Brazilian frontier. When the works were begun in August, 1888, the Central Uruguay Ry. reached no further than Pazo de los Toros, on the Rio Negro, 170 miles from Montevideo. The intervening country from there to Santa Anna was little better than a wilderness, destitute of roads, bridges or communication, and almost devoid of houses or population. The immediate result of this grand trunk line to Brazil will be to open up a tract of fertile land hitherto comparatively valueless."

### ELECTRIC RAILWAYS.

NEW YORK, N. Y.—The 50th. St., Astoria & Central Park Ry. Co. has applied for franchise, and the Board of Aldermen will give a hearing May 12. Vice-Pres., J. W. Mersereau.; Secy., F. A. Bartlett.

FULTONVILLE, N. Y.—The Fulton & Montgomery County Electric Ry. Co. has been incorporated by Robert Wemple, of Fultonville, and J. S. Satterly, of Fonda, to build a line, 7 miles long; capital stock, $75,000.

BUFFALO, N. Y.—The Buffalo, North Main St. & Tonawanda Electric Ry. Co. has been organized by L. F. W. Arend, Edward Rutherford and George N. Kaeeland, of Buffalo, with a capital stock of $60,000. The road will be 6 miles long.

NEWARK, N. J.—The Newark & South Orange Ry. Co. and the Ferry St & Hamburg Place Ry. Co. has been sold to a Newark syndicate for $1,500,000. The road will be double tracked and operated by an overhead electric trolly system. Among the members of the syndicate are Gottfried Krueger, Edgar B. Ward and Edward Rodell.

MONTCLAIR, N. J.—At a town meeting on April 5 it was voted to appoint a committee of seven citizens to consider the matter of street railways, and report to a public meeting of the citizens within 60 days. Three or four organizations are seeking a franchise, and one has made formal application, action on which has been postponed. An electric system is generally favored, and any company offering an electric system is likely to meet with greatest success.

ST. PAUL, MINN.—The St. Paul & White Bear Ry. Co. has been incorporated to convert the motor line to North St. Paul to an electric line, and will relay the track and build extensions. L. K. Stone, Col. H. M. Byllesby and H. C. Lewis are among the incorporators.

DENVER, COLO.—The Denver Land & Water Storage Co. proposes to build an electric railway, 30 miles long, to the Castlewood dam.

### HORSE AND MOTOR RAILWAYS.

WILLIAMSPORT, PA.—Vallamont Passenger Ry. Co., $10,000; Pres., J. Henry Cochran. South Side Passenger Ry. Co., $15,000; Pres., Fletcher Coleman.

HUNTINGDON, PA.—Huntingdon Street Ry. Co., $18,000, President, Samuel E. Henry.

CHICAGO, ILL.—Western Dummy Ry. Co., $500,000; Eugene H. Dupee, Lockwood Honore and A. A. Bliss.

### HIGHWAYS.

OHIO.—Proposals have been received from 15 bidders for 14 miles of turnpike road work. The County Commissioners have been authorized to issue $75,000 of additional road bonds.

### BRIDGES, TUNNELS AND CANALS.

MILWAUKEE, WIS.—The City Engineer has been ordered to prepare plans and estimates for a bridge across the Milwaukee River to connect the first and sixth wards of the city.

### WATER WORKS.

#### New England.

ANTRIM, N. H.—At the annual town meeting, D. H. Goodale, Dr. Christie and Henry Simonds were appointed to investigate the question of building works. Geo. D. Dresser, Town Clerk.

CONCORD, N. H.—A timber and masonry dam for manufacturing purposes will probably be built at Sewall's Fall, above this place. Des. Engr., E. F. Smith, Reading, Pa.

THE WEIRS, N. H.—It is expected that works will soon be built, including a pumping plant and a reservoir, the supply to be from a lake.

BROCKTON, MASS.—The city has received authority to issue $62,000 of additional water bonds.

FITCHBURG, MASS.—The Legislature has authorized the city to take water from Lake Wachusett, in the towns of Princeton and Westminster, and from Meeting House Pond and Wymans reservoir, in the town of Westminster. Bonds to the amount of $300,000 may be issued for proposed new supply. It is reported that contracts for the pipe have been let.

HYANNIS, MASS.—Works are projected.

MARBLEHEAD, MASS.—The town has been authorized to issue $50,000 additional water bonds.

MEDFIELD AND MEDWAY, MASS.—The Legislative Water Supply Committee has reported a bill to incorporate E. C. Wilson, E. V. Mitchell and others as the Medway Water Co.; proposed capital stock, $85,000. Another bill was reported incorporating E. V. Mitchell and others as the Medway Water Co.; capital stock, $50,000.

MELROSE, MASS.—The town has voted to issue $25,000 of additional water bonds, $14,000 of which will be used for construction.

NORTHAMPTON, MASS.—The Water Committee has bought the Mt. Tom mill privilege for $7,500, for a new supply.

NORTH BROOKFIELD, MASS.—The town voted March 30 to issue $100,000 of bonds for works. The supply, as recommended by T. C. Bates, Chn. Comrs., will be from Ferns and Horse Ponds, as storage reservoirs, with a distributing reservoir on Bell Hill.

ORANGE, MASS.—The town has authority to take water from North Pond and to issue $125,000 in bonds for works. It is reported that the town has voted to accept the act.

SPRINGFIELD, MASS.—It is expected that about four miles of 12 and 6-in. mains will be laid this summer, some of it replacing old cement pipe.

SOUTH NORWALK, CONN.—Engr. W. B. Rider informs us that the Commissioners have received petitions asking for extensions to the mains which would cost about $19,000.

#### Middle.

CARTHAGE, N. Y.—Works are again talked of. It is said that C. O. McComb, representing Hinds & Bond, Watertown, is ready to submit a proposition to build works.

EAST SYRACUSE, N. Y.—Agitation for works is continued.

GAINESVILLE, N. Y.—The town officers of this Wyoming Co. town propose to build works.

MEDINA, N. Y.—The contract between the village and Bauer, Bruff & Bros., Rochester, by which the village pays an annual hydrant rental of $40 each, has been signed. Works will be started this month, is is said. The supply will be pumped from a well through a 10-in. force main.

NEW PALTZ, N. Y.—It is said that the water-works question is still undecided.

ROME, N. Y.—The city has prepared a bill asking for

authority to issue $25,000 of bonds for a 20-in. main and appurtenances.

SACKETT'S HARBOR, N. Y.—Bids are wanted until April 23, by Capt. Chas. B. Thompson, U. S. A., for the reconstruction of the water-works of Madison Barracks. There will be a stand-pipe.

WESTFIELD, N. Y.—Bids are wanted until April 15 for 1,344 ft. 8-in., 3,096 ft. 6-in. and 7,440 ft. of 4-in. coated cast iron pipes and for specials, pig-lead and jute; also for trenching and pipe-laying and accompanying work. Geo. W. Patterson, Pres.; S. C. Crandall, Secy. Comrs.

CAMDEN, N. J.—The Stockton Water Co. has been incorporated to operate in Stockton Township by S. Twitchell, Philadelphia. J. W. Cheney, Camden, and others; capital stock, $100,000; Geo. Pfeiffer, Jr., Pres.; Frank Cheyney, Secy.; S. C. Twitchell, Treas. Contracts have been let. There will be a 20x100-ft. standpipe.

KEYPORT, N. J.—It is said that works are still wanted.

McKEESPORT, PA.—The Commissioners have recommended the purchase of five acres of land on Stewart or Douglas hills for a 10,000,000-gallon reservoir, and Cy. Engr. Patterson has been instructed to survey the site.

MIFFLINTOWN AND PATTERSON, PA.—It is said that the Patterson Water Co. has made the desired contracts with the Borough Councils of Mifflin and Patterson, and will begin construction soon.

PHILADELPHIA, PA.—Bids are wanted until May 3 for a 20,000,000 and for a 15,000,000-gallon pumping engine; also, until April 12, for boilers and various appurtenances to the Spring Garden pumping station extension. Address inquiries to John L. Ogden, Chief Bureau of Water, and bids to Jas. H. Windrim, Director Public Works.

PHILADELPHIA, PA.—The appropriations for 1892 provide for a 20,000,000, 15,000,000 and two 10,000,000-gallon pumps.

READING, PA.—City Clerk Fetter has been instructed to advertise for bids, to be handed in by April 12, for 2,700 ft. of 10-in. and 5,000 ft. of 6-in. pipe; for 140 iron stop valve boxes; also, by April 19, for 10 10-in. and 40 6-in. valves, and for 60 hydrants.

MIDDLETOWN, MD.—On April 4 the people voted $11,000 for works, and elected officials in favor of building works. Burgess, Geo. W. Remsburg.

### Southern.

MOUNT AIRY, N. C.—On May 2 a vote will be taken on the issuance of $30,000 of bonds for works.

WINSTON, N. C.—The Aldermen have asked the citizens to vote $100,000 for the purchase and extension of the works.

AIKEN, S. C.—April 23 the people will vote for or against works.

ATLANTA, GA.—The highest and lowest complete bids for the new pumping station were from Nichols Ittner, $113,650, and Miles & Brandt, $76,000. The contract was awarded to the latter for the price named. The station will be of brick, with stone foundations.

BUENA VISTA, GA.—April 15 the people vote on establishing works.

MACON, GA.—The Macon Gas Light & Water Co. desires bids until April 15 for furnishing and setting Thomson or Worthington meters.

DOTHEN, ALA.—Works are projected.

NEW ORLEANS, LA.—The New Orleans Water Works Co. has contracted for a National Filtering plant with a minimum daily capacity of 14,000,000 gallons. It os reported that a contract has been let for two 10,000,000-gallon Allis pumping engines.

### North Central.

CLEVELAND, O.—Bids will be received until April 13 for 11,400 ft. of 36-in. pipe and castings; for such 3 to 16-in. cast iron pipe and specials as will be needed in 1892; also, for building a 6-ft. aqueduct and three pump and gate wells at the Division St. pumping station. On April 20 bids are wanted for 200 4-in. and 12 6-in. hydrants; also, for 11 36-in., 1 24-in., 2 16-in., and approximately 10 12-in., 10 10-in., 40 8-in., 150 6-in., 300 4-in., and 5 3-in. gates, the first three sizes to have double screws.

PORTLAND, IND.—R. E. Lowry informs us that a 30-years franchise has been granted to Gardiner & McGlasson, Ashland, Ky. There will be two pumps with a combined capacity of 3,000,000 gallons, a 10 to 20x110 ft. stand pipe, 11 miles of mains and 150 hydrants. Mayor, F. H. Snyder.

BERWYN, ILL.—Works will be built by Andrews & Piper, including some six miles of mains.

JOHNSON'S CREEK, WIS.—It is reported that at a citizens' meeting about $12,000 was subscribed to the stock of a proposed water company.

WHITE FISH BAY, WIS.—The White Fish Bay Water, Light and Power Co. has been incorporated; capital stock, $50,000.

### Northwestern.

KEOKUK, IA.—A contract for a 3,000,000-gallon filtering plant has been let to the New York Filter Co.

FAIRMONT, NEB.—Water and electric lighting plants are projected.

SALEM, S. DAK.—Bids are wanted until April 20 for materials and labor necessary in repairing and extending the works; also for $3,500 of 7 per cent. 15-year bonds. Auditor, W. H. Cross.

HARTINGTON, NEB.—Works are being discussed.

### Southwestern.

RAWLINS, WYO.—A contract for building works has been awarded to Igo & Howard, Greeley, Colo., for $21,000. The works must be completed by Aug. 1.

BRENHAM, TEX.—It is reported that $16,500 has been subscribed for a water and ice plant.

VAN BUREN, ARK.—The franchise for works is reported as forfeited, owing to failure to begin operations.

HALLETTSVILLE, TEX.—It is reported that the mains will be extended.

CANADIAN, TEX.—It is reported that works will be soon be built.

DUBLIN, TEX.—The Southern Investment Co. has forfeited its franchise for works, it is said. Steps have been taken to organize a company.

NORTH DENVER, COLO.—The citizens are discussing the organization of a water company.

### Pacific.

MINERAL WELLS, TEX.—Works are needed. Estimated population, 1,000, besides visitors to the wells.

COLTON, WASH.—A supply from wells is proposed. Bids are wanted for the wells, and for pipes from the wells to the city.

FARMINGTON, WASH.—The citizens have expressed themselves in favor of water and electric lights.

WAITSBURG, WASH.—Bids are wanted until May 2 by R. R. Ormsbee, Cy. Clk., for 5,087 ft. of 4-in., 18,046 ft. of 6-in., and 4,076 ft. of 8-in. pipe; for 4,500 lbs. of specials; 22 4 to 8-in. stop gates; 25 double nozzle hydrants; laying pipe and setting hydrants and gates; constructing a supply well and reservoir. Engr., A. L. Adams, Pendleton.

WALLA WALLA, WASH.—A petition is being circulated in favor of $150,000 of bonds for water-works and sewers. The present works are owned by a company.

ARLINGTON, ORE.—Bonds to the amount of $10,000 have been voted for water and electroc lighting systems.

HILLSBOROUGH, ORE.—The Electric Light and Water Co. has been incorporated; capital stock, $40,000.

NAMPA, IDA.—The Nampa Water Co. has been incorporated.

### ARTESIAN WELLS.

EDDY, N. M.—It is reported that the Town Council has let a contract for boring 2,000 ft. for water, gas, oil or coal.

COLTON, WASH.—The Council wishes bids for sinking wells.

### IRRIGATION.

GLENDORA, CAL.—An election district was organized here some weeks ago, but a water supply has not been secured.

NEW COMPANY.—Lone Tree Ditch and Reservoir Co., of Denver, Colo.; Jas. W. Hampton, E. Armfruster and J. B. Kinley; $20,000.

### SEWERS.

LOWELL, MASS.—The contract for 500,000 sewer brick has been awarded to Ed. Cawley. The Council has voted to build the Moore St. and Water St. sewers, and bids will be asked at once for sewer pipe.

NEWTON, MASS.—Bids are asked until April 19 for sections 4 and 5 of the city sewer system; also, for 9,000 bbls. of cement. See advertisements. Albert F. Noyes, Cy. Engr., West Newton.

WALTHAM, MASS.—The city has been authorized to make additional loans for $75,000 for sewers and drains.

MERIDEN, CONN.—The organization of the sewer department has been completed, and C. P. Bassett, of Newark, N. J., engaged as consulting engineer. Bids will soon be asked.

NEW HAVEN, CONN.—The Committee on Sewers has recommended sewers in nine streets.

ROCHESTER, N. Y.—The City Treasurer has been authorized to issue sewer bonds to the amount of $200,000, but the Finance Committee will recommend that this be increased to $500,000. Bids are asked until April 12 for pipe sewers in five streets. Thos. J. Neville, Clerk.

JERSEY CITY, N. J.—Contracts have been awarded to T. Kelly, at $45,000, and H. H. Holmes, at $20,000. The bids will be published next week.

ORANGE, N. J.—The contract for the Valley section has been awarded to Reynolds, Conway & Co., of Newark, at $136,751, and that for the outlet section to the Passaic River to Lee, Smith & Co., of Paterson, N. J., at $134,747. The detailed bids will be published next week. Sewer bonds for $484,000 have been sold.

MONTCLAIR, N. J.—In the annual report of the Township Committee the estimated cost of the sewerage system is given at $400,000, which includes the town's share in the union outlet and main through Bloomfield. The Committee suggests that the question of sewers take precedence of all other matters, and that three intercepting mains, to cost $73,500, be built this year. The committee also advises the issuance of sewer bonds.

ERIE, PA.—Plans and estimates for about 7 miles of sewers have been prepared by the City Engineer.

JOHNSTOWN, PA.—The city has voted to construct a sewer in Ward 5, also to extend other sewers.

PHILADELPHIA, PA.—The city will build sewers in about 40 streets, including 16 sewers in Frankford.

HAGERSTOWN, MD.—The city has voted to issue bonds for $60,000 for drainage and street improvements.

MUNCIE, IND.—The lowest bid for the Mulberry St. sewer was that of T. Moore, $16,052. Ordinances have been passed for several other sewers.

DETROIT, MICH.—The city will re-advertise for lateral sewers.

FREMONT, NEB.—The plans of J. W. Andrews, Cy. Engr., have been approved, and a committee appointed to co-operate with the City Council to secure the right of way. The estimated cost of the system is $90,000, and bonds will be issued for this amount.

PORTLAND, ORE.—Plans have been completed for a sewer in the East Side. It includes about 4,000 ft. of 34 to 54-in. brick sewer, and 12 to 24-in. pipe sewers in side streets. T. M. Huriburt is City Surveyor.

OLYMPIA, WASH.—An engineer has been engaged to prepare plans and estimates for a system.

PUYALLUP, WASH.—The City Clerk asks bids until April 18 for a drainage system, aggregating 22,300 lin. ft., the largest drains to be 18 in. diameter.

WINNIPEG, MAN.—The contract for $11,000 worth of sewer pipe has been awarded to J. H. Ashdown, the pipe to be of Monmouth manufacture.

### STREETS.

NEW YORK, N. Y.—The Department of Public Parks asks bids until April 20 for four contracts for grading and paving.

ALBANY, N. Y.—Bids are asked until April 18 for paving two streets with dimension granite blocks. T. J. Lanahan, Clerk of Board of Contract.

BUFFALO, N. Y.—Bids are asked until April 19 for paving two streets with Barber's Trinidad asphalt, and one with German rock asphalt. Edwin F. Bishop, Secy., Bd. Pub. Wks. For paving East Ferry St. with asphalt, the Barber Asphalt Co. bid $105,371, and the German Rock Co., $107,791.

TROY, N. Y.—Bids are asked for an asphalt pavement on 6th. Ave.

NEWARK, N. J.—The Superintendent of Streets has been directed to ask bids for paving 11 streets.

JENKINTOWN, PA.—The town will issue bonds for $30,000 for macadamizing about three miles of streets.

PHILADELPHIA, PA.—The Council has passed the ordinance appropriating $325,000 to asphalt Broad St.

TOWSONTOWN, MD.—Bids are asked until April 12 for stone, to be delivered on the county roads. M. F. Connor, Clerk of Comrs.

WASHINGTON, D. C.—The estimated cost of the proposed removal of the parking from the middle of New York Ave. from 9th to 13th Sts. is $30,000.

ROANOKE, VA.—Several streets will be paved with vitrified brick.

PARKERSBURG, W. VA.—The paving bids have been rejected and new ones will be asked.

NEW ORLEANS, LA.—The contract for paving Levee St. with granite blocks has been awarded to Venable Bros., of Atlanta, Ga.

CINCINNATI, O.—The contract for the improvement of Eastern Ave. has been awarded to J. Donovan, at $84,358. The County Commissioners ask bids until May 4 for two contracts.

DAYTON, O.—Ordinances have been passed for paving nine streets.

YOUNGSTOWN, O.—The Council has voted $10,000 for sidewalks.

INDIANAPOLIS, IND.—The bids for asphalt paving in several streets have been rejected and new ones will be asked.

DUBUQUE, IA.—The contract for paving Main St. has been awarded to Atkinson & Oloff, of Rock Island, at $57,323. Galesburg brick will be used, one course on a concrete foundation.

ST. LOUIS, MO.—Bids are asked until April 19 for paving two streets with granite blocks. Geo. Burnet, Pres., Bd. Pub. Wks.

SAN FRANCISCO, CAL.—The Board of Supervisors has voted to pave four streets with bitumen and three with basalt blocks.

### ELECTRICAL.

BRAINTREE, MASS.—The city will issue bonds for $30,000, for an electric lighting plant.

SOUTH NORWALK, CONN.—The city has voted to spend $22,500 for a municipal plant.

BATH, N. Y.—A contract has been awarded to the Hyer-Sheehan Electric Motor Co., of Newburg, N. Y., for 43 arc lights, to burn 240 nights in the year from dusk until 1 a. m., at $68 per light per year.

JAMESTOWN, N. Y.—The Board of Public Works will spend $40,000 in enlarging the plant.

NEW ROCHELLE, N. Y.—The contract for lighting has been renewed at the following prices: 20 arc lights of 1,200 c. p. each, $125 per light per year; 108 incandescent lights of 25 c. p., $25 each.

WESTFIELD, N. J.—The village will erect a municipal plant to cost $12,000.

CHESTER, PA.—The Committee on Lights desires bids for 25 arc lights.

PETERSBURG, VA.—Bids are asked until April 30 for from 100 to 200 arc lights of 1,200 c. p. each, and 100 incandescent lights of 20 to 65 c. p., for 2, 3 or 5 years from Sept. 1, 1892. Bids are also asked for a complete electric plant, with or without motive power. Wm. Cameron, Chairman Com. on Gas and Lights.

BREWTON, ALA.—A plant will be erected by J. H. Turner, of Mobile.

HOPKINSVILLE, KY.—Bids are asked until April 25 for electric street lighting. W. J. Withers, Chn. Board of Councilmen.

LOUISVILLE, KY.—The proposed lighting contract will be re-advertised.

CLEVELAND, O.—The Brush Electric Light & Power Co. has submitted the following bids: Moonlight schedule, 4,000 and 2,000 c. p., $153, and $99.50; all night schedule, $175 and $87.50.

WADSWORTH, O.—The City Council desires estimates for a plant.

LITTLE ROCK, ARK.—Argenta has been annexed to the city, and a system of electric lights will be put in there.

FOND DU LAC, WIS.—Chas. D. Haines, of Kinderhook, N. Y., is arranging for an electric railway and lighting plant to cost $85,000.

BEATRICE, NEB.—The City Clerk has been authorized to ask for bids for electric lighting for streets and public buildings.

NEVADA CITY, CAL.—The city has awarded a contract for 37 lamps of 25 c. p. each, to burn till midnight, and 10 to burn all night, to K. Casper, at $800 per year.

ARLINGTON, ORE., AND FARMINGTON, WASH., have voted to issue bonds for municipal plants.

### CONTRACT PRICES.

STREET CLEANING.—Albany, N. Y.—Contracts have been awarded to John Kelly at 43, 45 and 46 cts. per load; J. H. Malcolm at 40 cts. and Ezra Bush at 30 cts. The contract for street sweeping was awarded to S. G. Davenport at 75 cts. per 1,000 sq. ft.

GRANITE.—New York, N. Y.—The Department of Docks has awarded a contract for granite stones for river wall to John Pierce at 99 cts. per cu. ft. for headers and stretchers, and $1.45 per cu. ft. for coping stones, all cut and delivered.

PAVING MATERIAL.—Baltimore, Md.—Contracts for Belgian blocks have been awarded: Booth Bros., $66.75 to $67.90 per M.; Rockport Granite Co., $65.90 to $68.20; Westham Granite Co., $67.50 and $68; W. F. Weller, $67; J. M. Maxwell & Sons., $68. The contracts for granite curb were awarded to John S. Filbert at 90 7-8 cts., and $1.02 1-4 per lin. ft., and for gutter stones, to J. H. Atkinson, at 28 cts. per lin. ft.

Lowell, Mass.—The contract for 20,000 lin. ft. of 6-in. granite edge stones has been awarded to H. E. Fletcher & Co., at 31 cts. per lin. ft. and that for 2,000 lin. ft. of granite flagging to L. P. Palmer at 35 cts. per lin. ft.

Holyoke, Mass.—The contract for 3,000 sq. yds. of granite blocks has been awarded to Timothy O'Keefe, of Chester, at $1.62 per sq. yd.

Springfield, Mass.—The contract for paving stone has been awarded to the Webb Granite & Construction Co., of Worcester, at $1.62 1-2 per sq. yd.

PAVING BRICK.—Louisville, Ky.—The contract for 1,700,000 vitrified paving brick has been awarded to the American Fire Clay Co., of New Cumberland, W. Va., at $13 per M.

BRICK PAVING.—Los Angeles, Cal.—A contract has been awarded to A. M. Austin at 28 3-4 cts. per sq. ft. for vitrified brick paving, and $1.15 per lin. ft for granite curb.

Streator, Ill.—A paving contract has been awarded to Edwards & Walch, of Davenport, Ia., at $1.37 per sq. yd. for Streator brick, and $1.48 for Galesburg brick; limestone or sandstone curbing, 53 cts. per lin. ft.

GRANITE PAVING.—Nashville, Tenn.—The contract for granite paving on Sumner St. has been awarded to J. B. Diver, at $2.29 per sq. yd.

LEVEE.—New Orleans, La.—The Board of State Engineers has recommended for acceptance the following bids: Lower Ascension, Ascension Parish, 80,000 cu. yds., P. J. Coffman, 11.8 cts. per cu. yd.; St. James' Estate to Point Brilliant, St. James, 60,000 cu. yds., A. Eltringham, 10.93 cts. per cu. yds.; Vacherie Road to Oak Alley, St. James, 60,000 cu. yds., C. D. Leeper, 10.49 cts. per cu. yd.; Corinne, St. Bernard, 4,000 cu. yds., J. J. Frawley, 16.99 cts. per cu. yd.

STONE DAM AND STEEL PIPE.—Syracuse, N. Y.—The Water Board opened proposals on March 31 for the work noticed in our issue of March 19. The first part of the work includes taking down the State's stone dam in the outlet of Skaneateles Lake, lowering the foundation about 6 ft., and rebuilding the dam; also taking down, moving and re-erecting the stone abutments of the bridge over the outlet of the lake at Main St., Skaneateles; also dredging and deepening the channel and outlet, the former to a depth of 45 ft., for a length of 1,600 ft., and the latter to a depth of 14 ft. for a length of 8,000 ft.; also constructing gate house, crib, trench, etc., and laying intake pipe. The second set of proposals was for about 6,500 lin. ft. of single riveted steel pipe 54 in. internal diameter and 3-8 in. thick, and 8 to 16 flexible joints; the sections are to be 29 ft. in length and afterward riveted into lengths of 116 ft., the pipe to be coated with asphaltum. The details of the several bids are given in the accompanying table. The bidders for work on the dam were as follows: (1) Moffet, Hodgkins & Clark, Syracuse, N. Y.; (2) E. J. Hingston & A. F. Chapman, Buffalo, N. Y.; (3) J. P. Hopkins, Lydon & Drews Co., Chicago, Ill.; (4) Wm. Patrick, Phenix, N. Y.; (5) John Moore, Syracuse, N. Y.; (6) Jas. H. Harlow & Co., Pittsburg, Pa. The bidders for pipe were as follows: (7) Groton Bridge & Mfg. Co., Groton, N. Y.; (8) Hilton Bridge Construction Co., Albany, N. Y.; (9) Carroll Porter Boiler & Tank Co., Pittsburg, Pa.; (10) Phoenix Foundry & Machine Co., Syracuse, N. Y.; (11) Ames Iron Works, Oswego, N. Y.; (12) McKee & Milson, Paterson, N. J.; (13) Porter Mfg. Co., Syracuse, N. Y. The contract for the dam, gatehouse, etc., has been awarded to Hingston & Chapman, and the contract for furnishing steel pipe, etc., to the Groton Bridge Co.

| Items. | Quantities. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | | $ | $ | $ | $ | $ | $ |
| Bailing and draining | | 1,413.80 | 1,500.00 | 1,500.00 | 10,000.00 | 5,000.00 | 5,000.00 |
| Remov. and replac. iron bridge | | 389.00 | 500.00 | 800.00 | 900.00 | 4,000.00 | 2 000 00 |
| Remov. timber and plank in structures | | 160.00 | 200 00 | 200.00 | 200.00 | 2,000.00 | 500.00 |
| Temporary foot and wagon bridge | | 361.00 | 300.00 | 500.00 | 1,475.00 | 700.00 | 650.00 |
| Earth exc. channel below dam | 24,000 cu. yds. | .25 | .50 | .48 | .65 | .40 | .75 |
| Earth exc. lake channel and trench | 21,000 " | .71½ | .50 | .50 | .96 | .50 | 1 40 |
| Earth exc., foundations | 7,000 " | .80 | .75 | 1.25 | 1 10 | .50 | 1.40 |
| Rock excavation | 100 " | 5.00 | 1.00 | 4.00 | 3.00 | 4.00 | 25.00 |
| Old masonry excavation | 1,000 " | .2[illegible] | .75 | 1.60 | 2.00 | 1.75 | 1.25 |
| Embankment | 4,000 " | .30 | .50 | .25 | .60 | .35 | .40 |
| Puddling earth—labor only | 1,000 " | .40 | 1.00 | .10 | .15 | .50 | .40 |
| Cobblestone paving | 70 " | 5.00 | 3.00 | 4.00 | 6.00 | 2.50 | 4.00 |
| Rubble walls, dry | 300 " | 3.75 | 4 00 | 4.60 | 5.00 | 4.00 | 6.00 |
| Rubble walls, in mortar | 50 " | 5.25 | 7.50 | 6.00 | 6.00 | 6.00 | 8.75 |
| Slope wall | 100 " | 5.25 | 3.50 | 6.00 | 6.00 | 4.00 | 7.50 |
| Loose stone or rip-rap | 1,800 " | 2.30 | 1.50 | 1.80 | 2.25 | 2.00 | 3.50 |
| Rubble masonry, stone dam and wells | 1,300 " | 9.00 | 5.00 | 9.00 | 7.00 | 13.00 | 8.75 |
| Rubble masonry, bridge abuts | 1,200 " | 8.55 | 5.00 | 7.00 | 9.00 | 10.00 | 9.00 |
| Cut stone coping, in mortar | 30 " | 25.53 | 16.00 | 25.00 | 15.00 | 30.00 | 21.00 |
| Dimension gray limestone—dressed | 10 " | 25.53 | 16.00 | 25.00 | 15.00 | 30.00 | 35.00 |
| Concrete masonry | 100 " | 7.35 | 5 50 | 6.00 | 5.00 | 6.00 | 6.00 |
| Brick masonry, in Portland cement | 50 " | 13.80 | 8.00 | 10.00 | 15.00 | 18.00 | 15.00 |
| Broken range ashlar | 450 sq. yds. | 2.70 | 5.50 | 8 00 | 7.00 | 10.00 | 3.00 |
| Rough pointed face dressing | 50 sq. ft. | .35 | .50 | .75 | .50 | 2.50 | 1.00 |
| Chiseled face dressing | 40 sq. ft. | 1.15 | 1.00 | .75 | .60 | 5.00 | 1.25 |
| Sawed hard wood timber—delivered | 50,000 ft. B. M. | 32.00 | 25 00 | 30.00 | 75.00 | 40.00 | 35.00 |
| Hard wood plank—hand driven | 20,000 " | 40.00 | 40.00 | 40.00 | 45.00 | 60.00 | 40.00 |
| White oak timber and plank | 18,000 " | 44.00 | 60.00 | 75.00 | 75.00 | 65.00 | 50.00 |
| White pine timber and plank | 5,000 " | 44.00 | 40.00 | 27.50 | 45.00 | 55.00 | 50.00 |
| Hemlock timber and plank | 60,000 " | 22.50 | 30.00 | 24.00 | 35.00 | 30.00 | 30.00 |
| Driving hard wood timber—machine | 500 lin. ft. | 3.20 | 2.50 | 7.25 | 6.75 | 7.50 | 4.00 |
| Driving sheet piling with machine foundation | 1,500 " | .20 | .06 | .18 | .20 | 3.50 | .70 |
| Gas pipe hand-rail—6 ft. post | 41 " | 1.50 | 2.00 | .80 | 4 00 | 5.00 | 1.00 |
| Gas pipe hand-rail, 3½ ft. post | 93 " | .70 | 1.50 | .80 | 2.00 | 4.00 | .70 |
| Cutting checks in masonry | 75 " | 1.30 | 1.00 | .50 | 2.00 | 6.00 | 3.00 |
| Laying 54-in. intake pipe | 6,500 " | 3.30 | 2.50 | 2.75 | 5.75 | 2.50 | 7.00 |
| Wrought iron | 9,700 lbs. | .04¼ | .03½ | .05½ | .10 | .06 | .10 |
| Cast iron | 1,200 " | .04 | .03 | .06 | .08 | .06 | .05 |
| Pressed spike | 1,500 " | .05 | .03¼ | .05 | .10 | .06 | .04 |
| Copper wire, No. 10 | 150 " | .33 | .50 | .30 | .40 | .65 | .50 |
| Cast iron, special casting | 40 tons | 65.00 | 50.00 | 70.00 | 75.00 | 100.00 | 75.00 |
| Valve gates and fixtures in dam | 6 No. | 272.75 | 440.00 | 325.00 | 570.00 | 425.00 | 3,600.00 |
| Valve gates and fixtures in wells | 2 " | 385.50 | 485.00 | 1,000.00 | 500 00 | 500.00 | 1,200.00 |
| Gate house of wood on dam | 1 " | 325.00 | 290.00 | 380.00 | 493.00 | 400.00 | 1,500.00 |
| Gate-house of stone and brick wells | 1 " | 2,600.00 | 1,000.00 | 1,800.00 | 1,975.00 | 2,100.00 | 500.00 |
| Total | | $101.358 | $86,574 | $105,395 | $152,013 | $125,556 | $191,408 |

| Items. | Quantities. | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|
| Steel pipe, 54 ins. diameter | 6,500 lin. ft. | $7.95 | $9.74 | $10.25 | $7.95 | $9 94 | $8.32 | $7.98 |
| Steel flexible joints | 16 No. | 350 00 | 330.00 | 265.00 | 400.00 | 369.15 | 420.00 | 300.00 |
| Steel reducer pipe, 72 to 54 ins. | 2 8 0 lbs. | 3½ cts. | 5¼ cts. | 4 cts. | 5 cts. | 5.8 cts. | 7½ cts. | 4½ cts. |
| Steel spigots and collars | 4,000 " | 3 " | 5 " | 5 " | 14 " | 8.3 " | 8 " | 10 " |
| Wrought iron hoop | 1,400 " | 3¼ " | 4 " | 3¼ " | 12 " | 8.24 " | 6 " | 5½ " |
| Cast iron sockets | 62,000 " | 2½ " | 3¾ " | 4 " | 4½ " | 3.32 " | 2½ " | 3½ " |
| Steel hook bolts | 14,000 " | 4 " | 10 " | 7 " | 12 " | 8.25 " | 5½ " | 7 " |
| Lead pipe | 3,000 " | 5½ " | 6 " | 5½ " | 5½ " | 5.72 " | 5¾ " | 5¾ " |
| Total | | $59,891 | $72,898 | $78,790 | $63,578 | $73,569 | $63,850 | $60,595 |

SEWERS.—Boston, Mass.—The Metropolitan Sewerage Commission has received the following proposals for Section 26 of the main sewer, in Charlestown and Somerville. The sewer will be 4,250 ft. long, 28 ft. average depth, 8 ft. 6 ins. outside diameter, with 3,150 cu. yds. of masonry. The contract was awarded to H. P. Nawn. The bidders were as follows: (1) J. J. Dorey and J. McCarthy, Somerville; (2) Metropolitan Construction Co., Boston; (3) Everson & Liddle, Providence, R. I.; (4) National Construction Co., Boston; (5) A. A. Hall, Boston; (6) Jones & Meehan, Jamaica Plain; (7) H. P. Nawn, Roxbury.

| | E'th excs. and refill. 6 ft. 5 ins. ×7 ft. 2 ins. 550 lin. ft. | 5 ft. 9 ins. ×6 ft. 6 ins. 3,700 lin. ft. | Rock excav. 400 cu. yds. | Masonry—Brick. Am. 1,400 cu. yds. | Port. 460 cu. yds. | Concrete. Am. 1,000 cu. yds. | Port. 200 cu. yds. | Rubble. Am. 100 cu. yds. | Sprce lum. in place. 30 M ft. B. M. | Spruce piles driven. 1,600 lin. ft. | Total. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $ | $ | $ | $ | $ | $ | $ | $ | $ | cts. | $ |
| 1 | 21.50 | 17.50 | 6.00 | 14.00 | 16.00 | 6.00 | 8.50 | 6.00 | 40.00 | .25 | 115.685 |
| 2 | 14. 5 | 14.75 | 6.00 | 12.75 | 14.75 | 5.25 | 7.00 | 1 00 | 35 00 | .14 | 97,662 |
| 3 | 15.00 | 14.00 | 2.50 | 12.00 | 14.50 | 6.50 | 8.50 | 6.00 | 35.00 | .15 | 94,520 |
| 4 | 18.12 | 13.75 | 6.00 | 11.80 | 13.80 | 5.10 | 6.75 | 5.25 | 33,00 | .17 | 94.244 |
| 5 | 13.55 | 13.56 | 4.75 | 12.78 | 15.78 | 5.00 | 7.68 | 5 00 | 30 00 | .15 | 92,766 |
| 6 | 16.00 | 13.00 | 6.00 | 12.50 | 14.00 | 5.00 | 7 00 | 6.00 | 26.00 | .15 | 90,470 |
| 7 | 13.00 | 10.00 | 3.00 | 12.25 | 14.00 | 5.00 | 6.00 | 5 00 | 30.00 | .20 | 76,740 |

WATER-WORKS SUPPLIES.—Richmond, Va.—The Committee on Water has awarded contracts as follows: West & Branch, Chapman hydrants, $21.93 each; Rensselaer Valve Co., 4-in. valves, $7.20 each; 6-in., $11.50; 8-in., $17.50; 10-in., $26.50; 12-in., $32.60; 16-in., $64.80; 20-in., $100; Glamorgan Co., 3-in. pipe, $24.25 per ton; 4-in., $24; 6-in., $23.75; 8 to 20-in., $23; Tredegar Co., specials, 2 1-4 cts. per lb.; Smith-Courtney Co., pig lead, 4 1-8 cts. per lb.; solder, 12 1-2 cts. per lb.

Fitchburg, Mass.—The Water Commissioners have contracted with the Radford Pipe Co., of Radford, Va., for 25 tons of 20, 24 and 30-in. pipe at $25.64 per ton of 2,240 lbs., delivered. The contract for lead has been awarded to the Chadwick Lead Co., of Boston, at 4 1-2 cts. per lb.

Washington, D. C.—The lowest bid received by the Commissioners was that of The National Foundry & Pipe Co., of Scottdale, Pa.; 3-in. pipe, $26.79 per ton of 2,240 lbs. on cars; 4-in., $25.67; 6-in., $25.11; 12-in., $24.55; specials, 2 1-8 cts. per lb.

Portland, Ore.—The Water Committee received three bids for 50,000 lbs. of lead. Selby Smelting Works and Goldsmith & Lowenburg bid $4.35 per 100 lbs., and Johnston & Lawrence, $5.74.

SEWER PIPE.—Akron, O.—The lowest bid received by the City Engineer for 4,000 lin. ft. of iron sewer pipe was that of the Lake Shore Foundry, of Cleveland, $18.95 per ton.

Revere, Mass.—The contract for salt glazed sewer pipe has been awarded to Waldo Bros., of Boston, as follows: 8-in., 10 3-4 cts. per lin. ft.; 10-in., 15 3-4 cts.; 12-in., 20 1-4 cts.; 15-in., 29 3-4 cts.; 18-in., 40 3-4 cts.; branches 2 ft. in length, 47 1-2 cts., 70 1-4 cts., 91 3-4 cts., $1.33, $1.80.

SEWER BRICK.—Minneapolis, Minn.—The lowest bid was that of J. A. Berg, $7 per M.

## MISCELLANEOUS.

PUBLIC BUILDING.—The House Committee on Public Buildings has reported favorably for buildings as follows: Joliet, Ill., $65,000; Gardiner, Me., $45,000; Massillon, O., $40,000; Buffalo, N. Y., $2,500,000.

JAIL.—Sumter, S. C.—The County Commissioners ask bids until April, 22, for a sheriff's residence and a county jail. B. D. Mitchell, Chn.

MASONRY.—Dayton, O.—Bids are asked for 500 perches of second-class culvert masonry on Dayton, Lebanon & Cincinnati Ry. H. E. Talbott, Ch. Engr.

CRIB WORK.—New York, N. Y.—Proposals are asked until April 14 for repairing two crib bulkheads, including upward of 42,000 cu. ft. of new work. Department of Docks.

NAVAL SUPPLIES.—Washington, D. C.—Bids are asked until April 19, for 38,058 lbs. steel plates, 37,347 lbs. steel shapes, also copper, brass, etc., for the New York Navy Yard; about 3,000 tons of broken stone, cement, etc., for the League Island Navy Yard; two stationary locomotive boilers, 7,200 lbs. steel plates, 7,500 lbs. steel Z-bars, for the Norfolk Navy Yard; also, for electrical supplies for Mare Island Navy Yard. Edwin Steward, Paymaster General, U. S. Navy.

GAS.—Denver, Colo.—The Denver Consolidated Gas Co. has decided upon $200,000 worth of improvements, including about 10 miles of pipe for its fuel gas system.

SUPPLIES.—Montreal, Que.—Bids are asked until April 27 for the following supplies for 1892: Vitrified clay pipes and inverts, lumber, spikes and hardware, brick, cement, and castings. Percival W. St. George, City Surveyor.

JETTIES.—Sea Isle City, N. J.—Five jetties. T. E Ludlam, Mayor.

## MANUFACTURING AND TECHNICAL.

LOCOMOTIVES.—The Schenectady Locomotive Works, Schenectady, N. Y., have an order for 7 ten-wheel and 20 twelve-wheel or mastodon engines for the Southern Pacific. They are all to be two cylinder compounds. The Pittsburg Locomotive Works, Pittsburg, Pa., have delivered several tank engines to the Manhattan Elevated. The Baldwin Locomotive Works, Philadelphia, Pa., have an order for 10 compound Forney tank engines for the Long Island. The Dickson Mfg. Co., Scranton, Pa., is building 8 engines for the Delaware Lackawanna & Western, and 5 consolidation engines for the New York, Ontario & Western. The Kentucky Union and the New York, Susquehanna & Western will purchase new engines.

CARS.—The Madison Car Co., Madison, Ill., is building 12 water tank cars for the Mexican Central. The St. Charles Car Co., St. Charles, Mo., is building 1,000 box cars and 500 coal cars for the Missouri Pacific. The Wells & French Co., Chicago, Ill., has an order for 125 ore cars for the Duluth & Iron Range. The New York, Susquehanna & Western has placed orders for 200 gondolas and 50 box cars. The Lafayette Car Works, Lafayette, Ind., have been sold to a local syndicate for $39,000. The Jones Vestibule Sleeping Car Co., of Denver, Colo., has been incorporated by Col. A. C. Fisk and E. W. Sebben, with a capital stock of $3,000,000.

NEW COMPANIES.—The Mozier Safety Signal Co., Galion, O., $50,000; A. M. Mozier, J. H. Green and W. E. Talcott. Kimball Railway Equipment Co., Springfield, Ill., $300,000; Daniel E. Kimball and A. L. Allen.

## CURRENT PRICE LIST.

RAILS.—New York: $30 at Eastern mills; $30.75 at tidewater; old rails, $20 for iron and $14 to $15 for steel; girder rails, $40. Pittsburg: $30; old rails, $21.75 for iron and $16.25 to $17 for steel. Chicago: $31.50 old rails, $19 to $19.50 for iron and $14.50 for steel.

TRACK MATERIALS.—New York: steel angle bars, 1.65 to 1.7 cts.; spikes, 1.95 to 2 cts.; track bolts, 2.6 to 2.75 cts., with square and hexagon nuts. Pittsburg: splice bars, 1.7 to 1.8 cts. for iron or steel; iron or steel spikes, 2.15 cts.; iron track bolts, 2.65 cts., with square and 2.75 cts. with hexagon nuts. Chicago: splice bars, 1.8 cts. for iron and steel; spikes, 2.15 to 2.2 cts.; track bolts, 2.65 to 2.75 cts. with hexagon nuts.

PIPE.—Cast iron, $20 to $30 per ton. Wrought iron, discounts as follows, at Pittsburg: 57 1-2 and 47 1-2 per cent. on black and galvanized butt-welded; 67 1-2 and 55 per cent. on black and galvanized lap-welded. Casing, 55 per cent.

FOUNDRY AND PIG IRON.—New York: $14 to $16. Pittsburg: $14 to $15. Chicago: $13.50 to $15.50.

LEAD.—New York: 4.2 to 4.3 cts. Chicago: 4 cts. St. Louis: 4.02 to 4.05.

STRUCTURAL MATERIAL.—New York: beams, 2.3 to 2.8 cts.; channels, 2.25 to 2.5 cts.; angles, 1.9 to 2.1 cts.; tees, 2.4 to 2.75 cts.; sheared iron plates, 1.85 to 2.25 cts.; steel plates, 1.85 to 1.95 cts. for tank, 2.05 to 2.25 cts. for shell, 2.35 to 2.65 cts. for flange, 3 to 3.25 cts. for firebox. Pittsburg: beams, 2.15 to 2.3 cts.; channels, 2.15 to 2.3 cts.; angles, 1.9 to 1.95 cts.; tees, 2.5 cts.; universal iron mill plates, 1.9 to 2 cts.; sheared steel bridge plates, 1.9 to 2 cts.; refined iron and steel bars, 1.75 cts.; steel plates, 1.9 to 1.95 cts. for tank, 2.15 cts. for shell, 2.25 to 2.3 cts. for flange, 3.75 to 4.15 cts. for firebox. Chicago: beams, 2.25 to 2.5 cts. for standard, 2.57 cts. for small, and 2.7 cts. for 20-in.; channels, 2.25 to 2.5 cts.; angles, 1.9 to 2 cts.; tees, 2.5 to 2.6 cts.; universal plates, 1.9 to 2 cts.; sheared steel plates, 1.95 to 2 cts.; steel plates, 2.3 to 2.4 cts. for tank, 2.6 to 2.75 cts. for shell, 2.9 to 3 cts. for flange.

## To Bridge Builders.

Sealed proposals will be received by the undersigned till 7 p. m., May 4, 1892, for building the superstructure of an iron viaduct connecting Garner and Division Sts., Cohoes, N. Y. It will consist of three spans, a center braced steel arch span of 200 ft., and two end spans of about 50 ft. each. General plans and specifications can be seen at the office of Edward Hayes, C. E., 38 Mohawk St., Cohoes, N. Y. No bid will be received unless accompanied by a certified check of $500. The Commission reserves the right to reject any or all bids. GILBERT O'BRIEN,
15-1t Chairman Viaduct Commission.

CAST IRON WATER PIPE.

Sealed proposals are invited until 2 p. m., April 25, 1892, for furnishing for the Stockton, N. J. water-works, cast-iron pipes and fittings, and for laying them; also standpipe and steam pumping machinery erected complete.

Specifications and plans may be seen at office of the Stockton Water Co., Cooper's Creek and Federal St., Camden, N. J., or at 1404 North 12th St., Philadelphia, Pa. George Pfeiffer, Jr., President, The Stockton Water Co.; Isaac S. Cassin, Engineer, 1404 N. 12th St., Philadelphia, Pa. 16-1t

## Proposals for Paving Brick.

Wilmington, Del., April 8, 1892.

Sealed proposals will be received by the Board of Directors of the Street and Sewer Department of Wilmington, Del., until April 26, 1892, at 7:30 p. m., for furnishing about 46,000 square yards of vitrified paving brick.

Specifications and full particulars may be obtained at the office of the Department.

Proposals must be addressed "Proposal for Paving Brick."

HARVEY J. WILEY, Secretary.

PROPOSALS FOR BUILDING DYKES AND DREDGING.

Office of the Board of Trustees,
St. John's River Improvement Fund,
Jacksonville, Fla., April 12, 1892.

Sealed proposals, in triplicate, for building dykes and dredging in the St. John's River, Florida, in the vicinity of Dame's Point, will be received in this office until 12 o'clock, noon, Standard time, on May 21, 1892, and then be opened.

Plans and specifications can be had on application to this office,

JAMES H. BACON.
Engineer in Charge.
16-4t.

## Seven Hundred Thousand Cubic Yards

Of grading and a large amount of street construction and sewering is to be done at Granite, five miles from St. Louis. Work to be commenced on or about May 1, 1892. The calculations are now being made to determine the amount of grading to be done and the average haul. Notice of the time when bids will be received and full particulars will be given shortly. 16-tf.

## Notice to Tunnel Contractors.

Bids for the construction of the tunnel of the Richmond & Chesapeake R. R. Co. along and under Eighth St., in the city of Richmond, Va., are hereby solicited. Plans and specifications can be had of the undersigned at his office 35 Broadway, New York City, with whom also terms can be settled.

N. E. REED, Pres.
New York, April 8, 1892. 16-tf.

WHERE ADVERTISING PAYS!

The proposals for the Mayfield extension of the water-works, published in Engineering News, cause many bids to come by mail. Thirty-five have been received at the office of the Water Board at this writing. Nineteen are from points in the state of New York, and the remainder are divided among the states of Ohio, Pennsylvania, Michigan, New Jersey, Illinois and Kentucky.—"Standard," Gloversville, N. Y., April 6, 1892.

## Notice to Contractors.

Notice is hereby given that sealed proposals will be received at the office of the City Clerk in Columbus, Nebraska, for the construction of a drainage ditch on the meridian line from the Union Pacific railway track to the Loup River.

Said proposals to be filed on or before 6 o'clock p. m. of the 28th day of April, 1892, and said ditch to be constructed in accordance with plans and specifications now on file in my office. Rejection of any or all bids reserved. GUS FALBAUM, City Clerk.

## Notice to Contractors.

DREDGING ROCK.—I desire to correspond with capable contractor as to cost of blasting and dredging rock bottom, for harbor. Address JOHNSON, care Kneeland & Co., New York. 15-3t.

## Sewer Contracts.

Battle Creek, Mich., March 28, 1892.

Sealed proposals will be received by the Board of Public Works up to 12 o'clock noon of May 16, 1892, for the following approximately described labor and material, each class to be bid upon separately.

1. Manhole frames or curbs, manhole covers and dirt pails.
2. Sewer pipe and specials for sewers mentioned below.
3. Bricks for sewers mentioned below.
4. Cement for same.
5. Furnishing material not mentioned above and constructing the following sewers:

900 lineal ft., 3 ft. 0 in. x 4 ft. 6 in. brick sewer, 8 in. shell.
800 lineal ft., 2 ft. 9 in. x 4 ft. 2 in. brick sewer, 8 in. shell.
270 lineal ft., 2 ft. 6 in. x 3 ft. 9 in. brick sewer, 8 in. shell.
800 lineal ft., 2 ft. 3 in. x 3 ft. 5 in. brick sewer, 8 in. shell.
300 lineal ft., 12 in. tile sewer.
450 lineal ft., 8 in. tile sewer.

Specifications, forms for proposals and other information may be obtained of the Chief Engineer. No proposal will be received except on the blank forms furnished by the Board.

Bidders must mark the envelopes containing proposals "Proposals for Sewers."

The bidders for classes 3 and 5 should state their experience, reputation and other qualifications for what they propose to do.

A satisfactory bond must be given by the successful bidder or bidders.

The Board reserves the right to reject any or all bids.

GEO. E. HOWES,
WM. C. GAGE,
J. M. WARD,
F. M. WADLEIGH,
H. C. HALL,
Board of Public Works.
W. W. BRIGDEN,
Chief Engineer. 16-2t

TREASURY DEPARTMENT, OFFICE Supervising Engineer, Washington, D. C., April 13, 1892.—Sealed proposals will be received at this office until 2 o'clock p. m., on the 13th day of May, 1892, and opened immediately thereafter, for all the materials and labor required for the decorative and other painting for the U. S. Court House and Post Office building at Denver, Colo., in accordance with the drawings and specification, copies of which may be had on application at this office, or the office of the Superintendent, at Denver, Colo. Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal. The right is hereby reserved to reject any or all bids, or to waive any defect or informality in any bid, if it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidders. Proposals must be enclosed in envelopes, sealed and marked "Proposal for the Interior Decorative and Other Painting for the U. S. Court House and Post Office Building, at Denver, Colo.," and addressed to W. J. EDBROOKE, Supervising Architect. 16—2t

TREASURY DEPARTMENT, OFFICE, Supervising Architect, Washington, D. C., April 14, 1892. Sealed proposals will be received at this office, until 2 o'clock p. m. on the 10th day of May, 1892, and opened immediately thereafter, for all the labor and materials required to put in place complete the iron columns, steel and iron floor, ceiling and roof construction, skylight roof, &c. complete, for the U. S. Court House, Post Office, &c., building at Detroit, Mich., in accordance with the drawings and specification, copies of which may be had at this office, or the office of the Superintendent at Detroit, Mich. Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal. The right is hereby reserved to reject any and all bids, and to waive any defect or informality in any bid, if it be deemed in the interest of the Government to do so. All bids received after the time stated will be returned to the bidders. Proposals must be inclosed in envelopes, sealed and marked, "Proposal for Iron Columns, Steel and Iron Floor, Ceiling and Roof Construction, &c., for the U. S. Court House, Post Office, &c., building at Detroit, Mich." and addressed to, W. J. EDBROOKE,
15-2t Supervising Architect.

ELECTRICAL SUPPLIES.—SEALED proposals, dated April 1, 1892, indorsed "Proposals for Electrical Supplies, Etc., for the Navy Yard, Mare Island, Cal." will be received at the Bureau of Provisions and Clothing, Navy Department, Washington, D. C., until 12 o'clock noon, April 19, 1892, and publicly opened immediately thereafter. Blank proposals will be furnished upon application to the commandant of the Navy Yard, the Navy Pay Office, San Francisco, Cal., or to the Bureau. EDWIN STEWART, Paymaster General, U. S. Navy.

NOTICE TO IRON CONTRACTORS.

Sealed proposals for furnishing and delivering F. O. B. cars at St. Cloud, Minn., iron work for the first story of a boiler house and store room to be erected at the Minnesota State Reformatory, will be received on or before May 5, 1892, at the office of the Mayor, St. Paul, Minn., at Eleven (11) o'clock a. m., at which time said proposals will be opened and contract awarded. Right reserved to reject any and all bids. For further particulars see specifications on file at the office of J. W. Stevens, Architect, Drake Block, St. Paul, or Superintendent's office, St. Cloud.

D. E. MYERS, Supt.
Dated St. Cloud, Minn., April 5, 1892.

## City of Boston.

BOSTON WATER-WORKS.

To Builders of Pumping Engines.

Sealed proposals addressed to the Boston Water Board, indorsed "Proposal for High-service Pumping Engine No. 3" will be received at the office of the Boston Water Board, City Hall, Boston, until 12 o'clock M. of Thursday, the twelfth day of May, 1892, and at that time will be publicly opened and read.

The price proposed is to cover all the expenses incidental to the completion of the work in full conformity with the plans and specifications. The price proposed must be stated both in writing and in figures, and all proposals containing bids not called for in this advertisement will not be entertained. Each bid must be signed by the bidder, and accompanied by a properly certified check for two thousand dollars ($2,000) payable to the city of Boston; said check to be returned to the bidder unless forfeited under the condition herein stipulated. No bid will be considered which is unaccompanied by a certified check, as aforesaid.

The amount of the security required for the fulfillment of the contract will be the sum of five thousand dollars ($5,000) in cash, and a bond for twenty-five thousand dollars ($25,000), with sureties satisfactory to the Boston Water Board and residents of Massachusetts.

The person or persons to whom the contract may be awarded will be required to appear at this office with the securities offered by him or them and execute the contract within six days (not including Sunday) from the date of notification of such award, and of the preparation and readiness for signature of the contract; and, in case of failure or neglect to do so, he or they will be considered as having abandoned it, and the certified check accompanying proposal shall be forfeited to the city of Boston.

Plans may be seen, and specifications and form of contract can be obtained, at the office of the City Engineer, City Hall, Boston.

The Water Board reserves the right to reject any or all bids, should it deem it to be for the interest of the city of Boston so to do. Boston Water Board, by

ROBERT GRANT, Chairman.
Office of Boston Water Board,
City Hall, Boston, April 11, 1892 16-2t

TREASURY DEPARTMENT, OFFICE SUPERVISING Architect, Washington, D. C., April 12, 1892. Sealed proposals will be received at this office until 2 o'clock, p. m., on the 12th day of May, 1892, and opened immediately thereafter, for all the labor and materials required for the cut stone work and brick work, iron and wood floor, ceiling and roof construction, roof covering, terra cotta works, &c., for the superstructure, of the U. S. Post Office building at Lowell, Mass., in accordance with drawings and specifications, copies of which may be had on application at this office or the office of the Superintendent at Lowell, Mass. Each bid must be accompanied by a certified check for a sum not less than 2 per cent. of the amount of the proposal. The right is hereby reserved to reject any or all bids, or to waive any defect or informality in any bid, if it be deemed in the interest of the Government to do so. All proposals received after the time stated will be returned to the bidder. Proposals must be enclosed in envelopes, sealed and marked, "Proposals for the Cut Stone Work and Brick Work, Iron and Wood Floor, Ceiling and Roof Construction, Roof Covering, Terra Cotta Work, &c., for the Superstructure of the U. S. Post Office building at Lowell, Mass." and addressed to W. J. EDBROOKE, Supervising Architect. 16-2t

TREASURY DEPARTMENT, OFFICE Supervising Architect, Washington, D. C., April 11, 1892.—Sealed proposals will be received at this office until 2 o'clock p. m., on the 22d day of April, 1892, and opened immediately thereafter, for all the labor and materials required for the plaster models of the ornamental stone work for the U. S. Court House, Post Office, etc., building at Detroit, Mich., in accordance with the drawings and specification, copies of which may be had on application to this office or the office of the Superintendent at Detroit, Mich. Each bid must be accompanied by a certified check for a sum not less than 2½ of the amount of the proposal. The right is reserved to reject any and all bids, and to waive any defect or informality in any bid, that may result to the interest of the Government. All bids received after the time herein stated will be returned to the bidders. Proposals must be enclosed in envelopes, sealed and marked. "Proposal for Plaster Models of the Ornamental Stone Work for the U. S. Court House, Post Office, etc., Building, at Detroit, Mich.," and addressed to W. J. EDBROOKE, Supervising Architect. 16-2t.

## Notice to Contractors.

Sealed proposals will be received at the office of the City Clerk of City of Monmouth, Ill., until 12 o'clock noon of Monday, April 25th, for the following approximate amount of work:

32,000 sq. yds. of brick pavement; 12,000 yds. of stone curbing; 14,000 cu. yds. of excavating. Plans, profiles, cross-sections and specifications can be seen at the office of the City Clerk.

The City Council reserves the right to reject any and all bids.

J. ARTHUR STEVENSON,
City Clerk.
Monmouth, Ill., April 12, 1892. 16-1t

## LABOR.

JOSEPH BRUNO, *Contractor.*

Italian laborers supplied and work superintended. Address 15 London St., East Boston, Mass.

DONATO CUOZZO,
*Contractor Italian Labor.*
See Adv., p. iv.

ANY CONTRACTOR

Or company needing laborers address M. MEOLA, Box 54, Wheeling, W. Va.

CHARLES P. MARTINO.

Italian laborers supplied for railroads, water works, etc. Address 242 N. 5th St., Brooklyn, E. D., N. Y.

PROPOSALS FOR DRY DOCK AT Puget Sound Naval Station, Washington.—Bureau of Yards and Docks, U. S. Navy Department, April 4, 1892.—Under authority conferred by the act of Congress making appropriations for the naval service, approved March 2, 1891, sealed proposals are hereby invited, and will be received at this Bureau until 1 o'clock p. m., on Tuesday, the fifth day of July, 1892, at which time and place the proposals will be publicly opened for the construction, by contract, of one dry dock 605 ft. long, with 30 ft. draft of water, with a body of timber and entrance of concrete and masonry, together with pump house, pumping plant, floating gate, culverts, and all other work pertaining thereto, in accordance with plans and specifications which can be seen upon application to this Bureau or the commanding officer of the Puget Sound Naval Station, Sidney, State of Washington. Proposals must be in duplicate, sealed and addressed to the Chief of the Bureau of Yards and Docks, U. S. Navy Department, Washington, D. C., and the envelope indorsed "Proposals for Dry Dock." Blank forms will be furnished on application. For additional information in regard to the location and site, bidders are referred to the commanding officer of the Puget Sound Naval Station. Satisfactory surety, as required in the specifications, must accompany the proposal, and no proposal will be considered unless accompanied by the prescribed bond. The successful bidder will be required, within fifteen (15) days after the acceptance of his proposal, to enter into a formal contract. The right is reserved to reject any or all proposals as, in the judgment of this Bureau, the interests of the Government may require, and to waive defects. N. H. FARQUHAR, Chief of Bureau.

## Notice to Contractors.

Sumter, S. C., March 18, 1892.

Sealed proposals will be received by the County Commissioners of Sumter County, S. C., at the office of County Commissioners, in the town of Sumter, until 12 o'clock noon, April 22, 1892, for furnishing all materials and building complete, a Sheriff's residence and County Jail, of brick, for said county, according to drawings and specifications furnished by Frank Niernsee, Architect. Drawings and specifications can be seen at the Clerk's office, in Sumter, or at architect's office, in Columbia, S. C. Bids will be received on the whole work in lump, or separate bids will be entertained for the jail building and Sheriff's residence only, and the steel, iron cage work, complete fixtures for interior. The successful contractor will be required to enter into bond of $10,000 for the faithful performance of said work. The Commissioners reserve the right to reject any or all bids deemed not to the best interest of the county.

B. D. MITCHELL, Chn.,
J. K. BROWN,
E. F. BURROWS,
Attest—Thos. V. Walsh, Clerk.

NAVAL SUPPLIES.—MARCH 29, 1892.—Sealed proposals, indorsed "Proposals for Naval Supplies for the New York Navy Yard, Etc., to Be Opened April 19, 1892," will be received at the Bureau of Provisions and Clothing, Navy Department, Washington, D. C., until 12 o'clock noon, April 19, 1892, and publicly opened immediately thereafter, to furnish at the New York Navy Yard 38,958 lbs. steel plates, 57,347 lbs. steel shapes; also a quantity of rolled sheet copper, copper tubing, brass tubing, steam and compound gages, and at the Naval Laboratory, Brooklyn, N. Y., a quantity of bedding, surgical instruments and appliances, hospital furniture, etc. The articles must conform to the Navy standard and pass the usual naval inspection. Blank proposals will be furnished upon application to the Navy Pay Office, New York, or to the Bureau. The attention of manufacturers and dealers is invited. Tie bids, all other things being equal, decided by lot. The Department reserves the right to waive defects or to reject any or all bids not deemed advantageous to the Government. EDWIN STEWART, Paymaster General, U. S. Navy.

OFFICE OF LIGHT-HOUSE ENGINEER, Fourth District, at Philadelphia, Pa., April 13, 1892.—Proposals will be received at this office until 12 o'clock m., on Thursday, the 28th day of April, 1892, for furnishing the material and labor of all kinds necessary for an addition, alterations, etc., to the Assistant Keepers' dwelling at Absecom Light Station, Atlantic City, N. J. Forms of proposal and drawings and specifications, showing what is required, can be had or seen by applying to this office. The right is reserved to reject any or all bids, and to waive any defects. EDWARD MAGUIRE, Captain of Engineers, U. S. A., Light-House Engineer. 16-1t.

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"The Loop Line," for Metropolitan Railway Co., Kansas City, Mo.
Seventh Street Line, for Washington & Georgetown R. R. Co., Washington, D. C.
Eleventh and Thirteenth Sts. Line, for Tacoma R'y & Motor Co., Tacoma, State of Washington
Navy Yard and Georgetown Line, for Washington & Georgetown R. R. Co., Washington, D. C.
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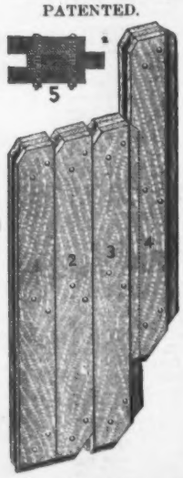


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